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RESEARCH AND MANAGEMENT PLAN FOR THE HAWAIIAN MONK SEAL AT FRENCH FRIGATE SHOALS, 1993-96

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ADMINISTRATIVE REPORT H-93-08

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Southwest Fisheries Science Center
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BACKGROUND

The largest Hawaiian monk seal (*Monachus schauinslandi*) population is located at French Frigate Shoals (FFS) in the Northwestern Hawaiian Islands (NWHI). This population grew from beach counts of a few dozen seals in the late 1950s (Rice 1960) to counts of approximately 200 seals in the late 1970s (Johnson et al. 1982). The population at FFS increased again during the early 1980s. The mean beach count rose to 284 in 1986, and the number of births peaked at 127 in 1988 (Fig. 1).

In 1990, births at FFS and all other major breeding sites in the NWHI declined significantly. The decrease in number of births for all populations combined was over 35%. Births at other sites returned to expected numbers in 1991 but continued to drop at FFS, where only 82 pups were born (Fig. 1). Data from a group of known adult females suggested that the low number of births was due to a drop in birth rate rather than a loss of adult females (Fig. 2). Of these known adult females, only 33% gave birth in 1990, and 36% in 1991. In 1992 the birth rate increased to just over 50%, and the number of births at FFS recovered (partially) to 102.

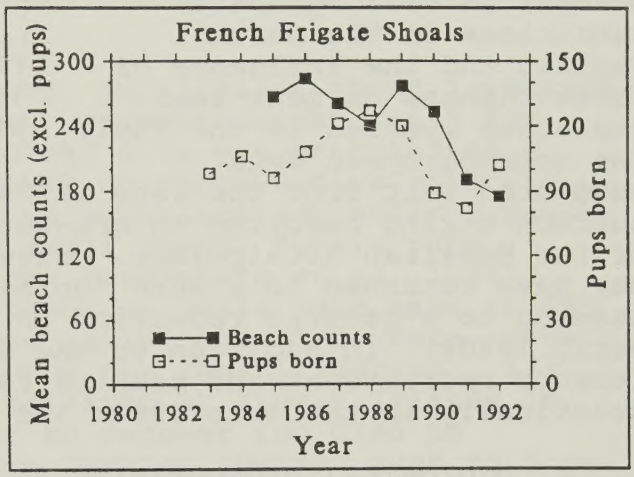

Figure 1. Mean beach counts (excluding pups) and number of pups born at French Frigate Shoals, 1983-92.

In 1991-92, beach counts at FFS also evidenced changes in the composition of the population (Fig. 3). In particular, sightings of juveniles and subadults decreased, indicating that the survival of seals in these size classes was low. Furthermore, observations of the surviving seals revealed that a high percentage were in poor physical condition (Appendix A). Growth data collected since 1984 have demonstrated that weaned pups at FFS are smaller than pups at other locations and that after weaning, growth of seals at FFS continues at a slower rate. This slower growth rate is consistent with preliminary data suggesting that females giving birth for the first time are older at FFS than at other locations. These observed changes in growth rate, birth rate of adult females, and survival of young seals suggest that the FFS monk seal population may be near carrying capacity (K) and has been significantly food stressed during these last few years.

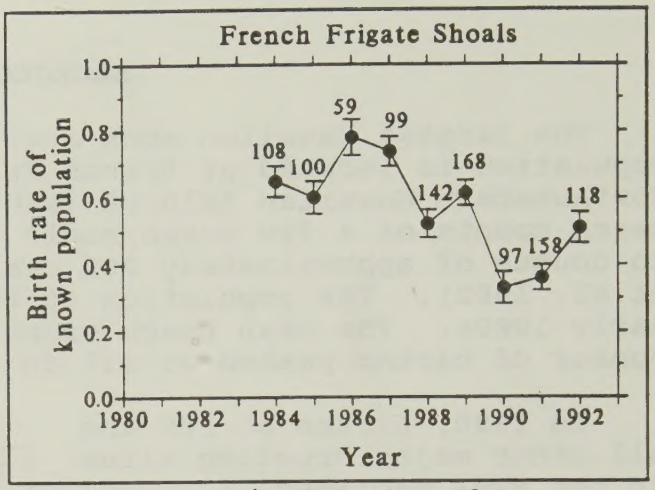

Figure 2. Birth rate of identified adult-sized females at FFS, 1984-92.

In December 1992, the National Marine Fisheries Service (NMFS), Honolulu Laboratory and the University of Hawaii, Joint Institute for Marine and Atmospheric Research, co-sponsored a "Workshop on Variation in the Marine Environment and Ecosystem around the Hawaiian Islands." The purpose of the workshop was to review recent changes in oceanographic conditions in the North Pacific and the influence of those changes on monk seals and other species in the NWHI. The oceanographic data suggested that from the late 1970s to the late 1980s increased surface mixing resulted in greater productivity in the vicinity of the Hawaiian Archipelago. However, oceanographic conditions may have returned to a more "normal" state in the late 1980s, leading to a general reduction in biological productivity in the early 1990s. In addition to the declines observed in monk seals, lobster recruitment and seabird reproductive success also dropped drastically in the late 1980s and early 1990s.

If biological productivity in the vicinity of FFS has declined, and remains low relative to that in the 1980s, then the monk seal population will have to adapt to a lower level of food resources. Importantly, we do not know (1) whether productivity has yet stabilized (or even whether it will stabilize), (2) how long the population may require to adjust to the lower level of prey resources, and (3) what adjustments will occur in the size and age/sex structure of the population. However, during the next 5-10 years, reproductive recruitment and the number of births can be expected to drop again because the low birth rate and survival of juvenile seals during the last 2-3 years has substantially decreased the number of females in these age classes.

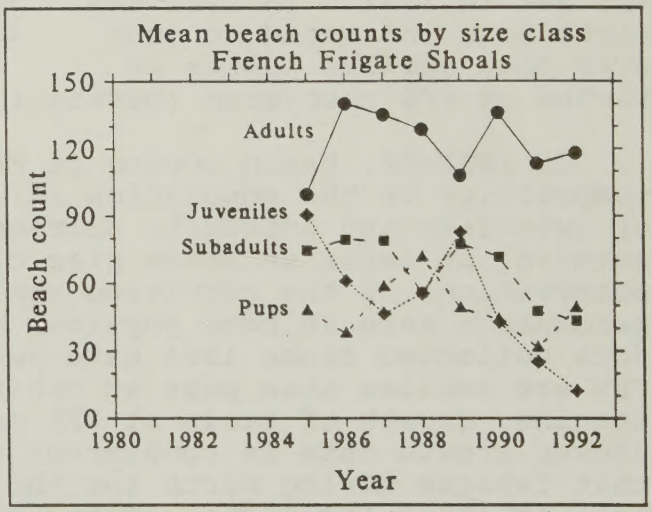

Figure 3. Composition by size class of the French Frigate Shoals population of Hawaiian monk seals, 1985-92.

During the winter of 1991-92 and in March and April 1992, an unusually high number of emaciated juvenile seals were sighted at FFS (Appendix A). To investigate the possibility that the poor condition of these seals was related to disease, the NMFS Marine Mammal Research Program (MMRP) conducted a disease survey in late April and early May. Nineteen juvenile seals were examined and sampled for blood cell counts and serum chemistry profiles, antibody titers to a spectrum of potential diseases, viral cultures, *Salmonella* cultures, and gastrointestinal parasites (Appendix A). The results of the survey suggested that disease was not the cause of the observed poor condition of juvenile seals. In general, the information gathered in the spring and summer suggested that juveniles were unable to find sufficient prey.

Because of their poor condition, survival of these juveniles was expected to be low. Collection of underweight seals for rehabilitation and release at another site was proposed as a mechanism to increase their survival to reproductive maturity. Since 1984, such rehabilitation and translocation efforts have been conducted successfully with small weaned female pups (Gerrodette and Gilmartin 1990; Van Toorenburg et al. 1993). Therefore, two additional collections of seals were made at FFS in 1992. Five female and two male seals, ages 1-3 years, were collected in May and brought to Oahu for rehabilitation. All five females recovered and were released at Midway Islands in August; the two males were unable to recover and died in captivity. In September, ten more females (weaned pups to 3 yr-olds) were collected at FFS. One seal died in captivity at FFS, but the remaining nine were taken directly by ship to Midway. At Midway, four of these seals were released during October-November, two died in captivity at Midway, and three were returned to Oahu for more intensive rehabilitation and care. By January 1993, the condition of the latter three seals had dramatically improved, and they were flown to Midway and released.

The Hawaiian Monk Seal Recovery Team reviewed the FFS population data through 1992 and the results of these rehabilitation projects at its 4-5 January 1993 meeting in Seattle, Washington. The Team developed a list of recommendations regarding future population monitoring and collections of seals for rehabilitation (Appendix B). On 5 February, a meeting of veterinarians and monk seal care staff at the NMFS Honolulu Laboratory reviewed the rehabilitation and care procedures of 1992 and made recommendations to the MMRP regarding these methods. The suggestions from these meetings, together with the concerns and experience of the MMRP, were used to develop the FFS population research and management agenda for 1993-96, as outlined below.

RESEARCH AND MANAGEMENT ACTIONS

It appears that decadal scale fluctuations in oceanic conditions have resulted in large perturbations to the environment supporting the Hawaiian monk seal population at FFS. However, this anomaly is not sufficiently understood to know whether changes may continue or if a relatively constant state in the ecosystem has already been reached. Further, the composition of the Hawaiian monk seal population may require many years of adjustment to changes in the level of prey availability, even in the absence of further significant environmental variation. It is also possible that the reduction in prey could result in more fishery interactions with the bottomfish and lobster fisheries in the NWHI. Because 40-50% of the entire Hawaiian monk seal population occurs at FFS, it is critical that trends in the population and the environment are documented. Such information will expand our knowledge of this vital relationship between monk seals and their environment, and this knowledge will most certainly aid management in defining population recovery goals at FFS and all other islands.

The following research and population management actions are planned for execution at FFS by the MMRP during 1993-96. The exact costs of many of these operations cannot easily be separated from other concurrent MMRP field research, logistical support, and data analysis efforts; therefore, the cost of this FFS research will be presented in a new version (1994-96) of the current Hawaiian monk seal work plan for Fiscal Years 1991-93 (Gilmartin 1990). The FFS plan activities are arranged in priority order below.

1. Monitor the population--This task includes sufficient annual observation and data collection to estimate the age and sex composition of the population; estimate survival and condition of tagged cohorts; tag weaned pups and immature seals without tags; estimate the reproductive rate and number of births; release entangled seals and collect, sample, and destroy potentially entangling debris; record aggressive behavior (mobbing or harassment by adult males) and resulting injuries; document injuries from sharks; document any evidence of fishery interactions; evaluate movement of seals between FFS and other locations; monitor deaths and disappearances; and perform necropsies.

The annual estimates of number of births, population composition, birth and survival rates, and other population data will be published in NOAA Technical Memorandums and will enable a continuing assessment of the status and trends in this population. These data are critical as they may dictate changes in the management strategy for this monk seal population.

2. Rehabilitate and relocate seals--Collection of small, female weaned pups for rehabilitation will continue. Recent reassessment of juvenile survival data indicate that rehabilitation will benefit seals that are weaned at an axillary girth of 95 cm or less. Survival of FFS juveniles will be reevaluated annually to determine whether this size criterion should be adjusted for future collections. Rehabilitated seals will be released at sites in the western NWHI, and their growth and survival will be monitored for comparison with seals both at FFS and in the recipient population.

While the primary collection and rehabilitation effort will be directed at small weaned female pups, juvenile females in poor condition may also be taken if space is available at the rehabilitation facilities. The maintenance, transport, disease screening, and general captive care of these seals will be as in the recent past, with the exception that seals held at FFS for transport to Oahu will be fed whole herring after 2-3 days on a liquid diet. This change in feeding protocol should enable the seals to gain weight faster and decrease the probability of an inhalation pneumonia resulting from a formula feeding.

Each cohort of tagged seals at FFS will be monitored annually to determine whether removal of females (either as weaned pups or juveniles) is creating an imbalanced sex ratio that might lead to mobbing or otherwise threaten the remaining females. If warranted, the rehabilitation program would be modified accordingly. Modifications could include alteration of the size criterion for selecting females, collection and translocation of males, changing the number of seals removed from the population, or even return of rehabilitated seals to FFS.

3. Monitor growth rates of juvenile seals--Growth data collected in 1992 indicated that weaned pups, and 1- and 2-yr-old seals were smaller at FFS than at Laysan Island. Differences may also exist in older seals between these two sites, but weight data were not collected on subadult or adult seals. The study of growth patterns of young seals should continue at FFS and Laysan Island, as well as at the various release sites in the western NWHI. In addition to assessing differences in growth of seals among the island populations, this information is important for contrasting growth patterns and condition of resident versus rehabilitated and relocated seals.

4. Complete FFS data analysis and field reports--FFS population data from past years of MMRP monitoring should be summarized and published in NOAA Technical Memorandums as soon as possible. This effort should be completed by the end of Fiscal Year 1994. These data were collected in the 1980s during the last phase of growth of this population and are critical to proper interpretation of the recent declining trends.

5. Conduct disease monitoring--The poor condition of many animals at FFS warrants continued monitoring of this population for infectious diseases that could manifest themselves in these debilitated seals. Seals in age classes suffering high mortality should be sampled annually. At a minimum, blood sera will be collected and tested for antibody levels to distemper virus, leptospirosis, parvovirus, and toxoplasmosis. Also, depending on circumstances and available logistics, bacterial or viral cultures and stool parasite examinations may be performed.

A finding of exposure and losses in monk seals at FFS caused by an infectious disease would necessitate a complete and immediate evaluation of the potential management options to control spread of the disease. While not to be dealt with in this document, a response plan should give consideration to (1) any historical information concerning the identified infectious agent in other pinnipeds; (2) potential for spread to other island populations; (3) probability of treatments or immunizations controlling the agent; and (4) the feasibility of implementing control, treatment, or eradication programs given the limited access to some islands, limited access to all seals due to differences in individual hauling patterns, and disturbance consequences of the actions.

6. Study foraging patterns and prey preferences--The movement patterns of seals around the atoll and the depth to which they dive to feed must be assessed. In 1992, satellite-linked time-depth recorders were used successfully at FFS to gain information on the at-sea positions and diving patterns of three subadult males. This preliminary study should be expanded in 1993 to include investigation of methods to provide higher quality positional data for seals at sea and assess the variability of individual foraging patterns. These additional data will enable a larger project to be designed to fully document the foraging behavior of the different age and sex classes.

Collection of monk seal scats and spewings for prey species determination should continue. Expertise capable of identifying the prey species from the sifted materials should be enlisted and annual field collections of prey parts keyed out between field seasons. Samples should be collected at FFS for comparison with similar data from the early 1980s and to monitor current prey preferences. Prey preference should be monitored in a similar manner at the other four major breeding sites to enable evaluation of differences among FFS and the other locations. Additionally, a method of monitoring reef productivity should be developed for implementation in the NWHI so that prey availability data may be available in the future to compare to monk seal population changes.

Importantly, the assessment of foraging locations using satellite telemetry and determination of prey species from scats and spews is necessary to determine the full extent of

interactions between monk seals and fisheries. Monk seals are known to interact with fishing gear and vessels, but the extent of indirect interaction (i.e., through competition for prey) is not known. The latter may have influenced the monk seal population trends recently observed at FFS. Therefore, further investigation of monk seal prey and foraging locations is vital to any assessment of such interactions with fisheries.

7. Assess FFS seal movement and tag loss--Seals born (and tagged) at FFS have been observed at Nihoa and Necker Islands. However, funding has not been available to assess the number of FFS emigrants at these sites. A quantitative assessment of movement from FFS to Necker and Nihoa Islands is necessary to accurately evaluate mortality of seals at FFS, and to understand the relationships among these three populations.

An accurate evaluation of mortality of tagged seals also requires an estimate of tag loss. While tag loss is known to be low, the loss rate should be determined more precisely to minimize bias in FFS mortality estimates.

8. Evaluate more practical permanent marking methods--Passive induced transponder (PIT) tags have been applied to weaned monk seal pups since 1991. While these tags provide a means of permanent identification, they require that the electronic tag-reading "wand" be within 10 cm of the tag. This can be difficult to impossible to manage on small islands at FFS where seals are lying near each other and are easily disturbed. New, larger PIT tags are now available which can be read at a much greater distance. Use of these larger tags should be evaluated for application when weaned pups are flipper-tagged. The feasibility of using a jab stick to apply PIT tags to older, unrestrained seals should also be investigated by the end of 1994. If a safe method of jab-injection of tags is developed, then the entire population should be PIT tagged.

9. Compare seal hauling behavior at FFS with single island sites --Hauling patterns have been documented for the various age/sex groups of monk seals at Laysan and Lisianski Islands, and the results have been used to estimate population size and composition at all monk seal breeding sites (Gilmartin et al. in press). However, the validity of this approach for a large multi-island atoll has not been tested. At FFS, these hauling patterns would be assessed by radio-tagging representative samples of the different age/sex groups. The results should provide improved estimates of the size and composition of the FFS population of monk seals.

The research to document hauling patterns at FFS will be designed in Fiscal Year 1994 and include a pilot study during that summer as a test of the radio-tagging method. If expansion of the effort is justified, then the hauling research will be conducted at FFS in the 1995 field season. A report detailing

the FFS research findings, including estimates of the size and composition of the FFS population and comparing these hauling patterns to the Laysan and Lisianski Island data, will be completed during Fiscal Year 1996.

OTHER RECOMMENDATIONS

The above recommended research and recovery activities will guide the planning of the MMRP for operations at FFS. These projects, however, do not address all of the information needs and actions which have been identified by the Recovery Team (Appendix 2) and the Marine Mammal Commission. They have also made non-research recommendations related to the observed population changes at FFS. These additional tasks are not the responsibility of the MMRP and therefore require attention by other programs within NMFS or other agencies. The recommendations include continuation and expansion of the fishery observer program in the NWHI, repair of the seawall at Tern Island (FFS), mitigation of disturbance to monk seals during seabird and turtle surveys in the NWHI by the Fish and Wildlife Service, and evaluation of the proposition that decadal-scale oceanographic fluctuations are responsible for recent changes in biological productivity in the NWHI.

CONCLUSION

The demographic changes observed in the Hawaiian monk seal population at FFS suggest that it is currently near K. The goals of this plan are to mitigate the demographic consequences of an apparent reduction in prey available to this population and provide information necessary for management to monitor adjustment of the population to its new resource base. In addition, the rehabilitation and translocation of juveniles in poor condition provides a mechanism to improve their condition and thereby increase their survival to reproductive maturity. Continued monitoring will provide information needed to understand the relationship between the size and status of this population and its environment. An understanding of this relationship at FFS should enhance our ability to manage not only this population but the entire species.

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APPENDIXES

APPENDIX A

Collection of juvenile monk seals at French Frigate Shoals for rehabilitation and release at Midway Islands

William G. Gilmartin and Timothy J. Ragen

Introduction

The French Frigate Shoals population of Hawaiian monk seals is continuing the decline which began in 1990. Atoll counts suggest that over the past year the number of subadults and juveniles has decreased substantially. Furthermore, a high proportion of observed seals from these age groups are severely emaciated; their chance of survival is correspondingly reduced. Reproduction (number of pups born) is approximately the same as last year, well below the annual number of births in the late 1980s. This report summarizes population data currently available on this decline, investigations to determine its nature, remedial actions taken to minimize its consequences, and recommendations for continuing efforts.

Population data

Between April 4th and July 3rd, 5 counts of Hawaiian monk seals were conducted at French Frigate Shoals. The totals, excluding pups, were 146, 159, 163, 170, and 169; the mean of these counts is 161. In 1991 the mean count was 191 (range 159 - 238). Comparison of 1992 counts with counts of previous years indicates this population is in its third year of decline (Fig. 1).

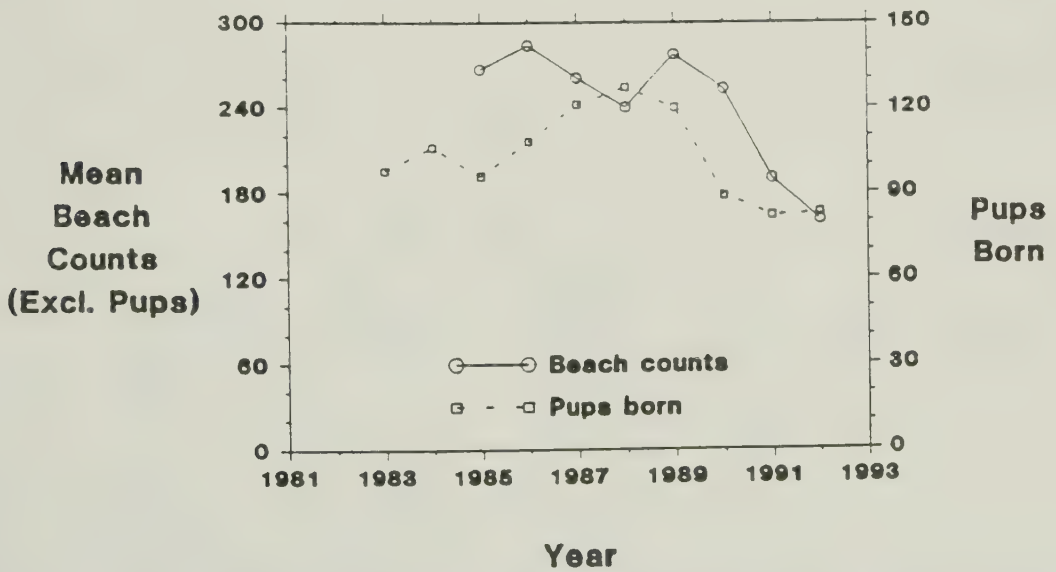

Figure 1. Mean annual beach counts and number of pups born at French Frigate Shoals. Note that data points for 1992 are based on 5 atoll counts.

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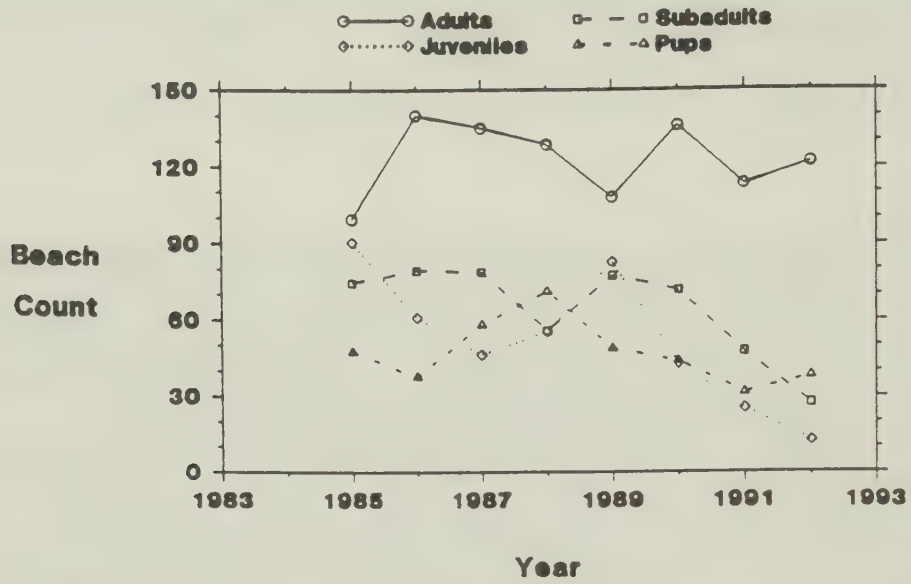

Figure 2. Mean annual beach counts for each age class at French Frigate Shoals; age class is determined subjectively.

The decline appears to be due to loss of subadults and juveniles (Fig. 2). These size classes are at their lowest level since annual population monitoring by this program began at French Frigate Shoals in 1984. If hauling patterns have not changed substantially, and animals on the beach represent approximately 40% of the total population at any one time (Gilmartin et al., in press), then the reduction in atoll counts suggests a total loss in the population on the order of 75 seals during the last year.

Furthermore, a high proportion of the surviving juveniles and subadults are severely emaciated. Over half of the juveniles sighted during the first 5 atoll counts in 1992 were considered to be either emaciated or thin (Table 1); as noted above, their chance for survival is correspondingly reduced.

Table 1. Condition of juveniles sighted during the first five atoll counts of 1992 at French Frigate Shoals.

Atoll Count	Emaciated	Thin	Thin - Healthy	Healthy	No estimate
1	4	3	4	2	0
2	2	4	2	0	3
3	3	2	4	2	1
4	1	6	0	2	2
5	2	5	4	0	4
Total	12	20	14	6	10

3

Table 2. Condition of seals by age class for the first five atoll counts of 1992 at French Frigate Shoals.

Year of Birth	# Seen / # Born	Emaciated	Thin	Thin-Healthy	Healthy	No Estimate
1991	34/82	15	7	4	1	7[1]
1990	16/89	4	2	5	3	2
1989	28/120	4	7	3	4	10

[1] Includes 4 animals known to be dead.

The majority of juveniles and subadults were tagged as pups and their ages can be determined. The condition of animals in each of the last three cohorts are presented in Table 2. Eighty-one percent of the yearlings sighted in 1992 were considered to be either emaciated or thin. Similarly, 43% and 61% of 2-yr-olds and 3-yr-olds, respectively, were classified as emaciated or thin. Note also the low number of seals sighted from each age group. The number of resighted individuals for each cohort will probably increase as more counts are conducted. However, the increase is expected to be small, and the overall resighting rate will probably remain alarmingly low.

In addition to the subjective classification of seal condition, measurements of weight and length have been taken as part of an ongoing juvenile growth study. Preliminary results are presented in Table 3 to provide a comparison of 1- and 2-yr-olds from 1991

Table 3. Weights and lengths of 1-yr-olds (yearlings) and 2-yr-olds in 1991 and 1992. These preliminary results are from an ongoing study of immature growth patterns.

		Cohort / year			
		1-yr-olds 1991	1-yr-olds 1992	2-yr-olds 1991	2-yr-olds 1992
Weight	Mean	115.0	85.4	134.1	121.0
	Std. Dev.	± 25.0	± 26.0	± 33.4	± 11.6
	n	24	20	32	5
Length	Mean	134.9	131.2	142.1	146.4
	Std. Dev.	± 7.8	± 7.5	± 9.5	± 2.2
	n	22	19	31	5

and 1992. Note, in particular, that 1- and 2-yr-olds in 1992 weighed substantially less than 1- and 2-yr-olds in 1991. Hence, preliminary information from the first 5 atoll counts indicates that resighting rates for immature seals is very low, and many of the animals resighted are in very poor condition.

In addition, the number of births also remains low (Fig. 1). In 1991 there were 82 births at FFS. There have been approximately 83 births this season, and while there may yet be a few additional births, the total number will still be substantially less than the annual number of births in the late 1980s.

These data indicate a continuing and severe problem for the FFS population of monk seals. Combined with recruitment failures of sea birds and spiny lobsters, these data suggest the most likely cause is lack of available food resources. At the January 1992 meeting of the Hawaiian Monk Seal Recovery Team, Bill Gilmartin suggested that one possible remedial action might be to relocate emaciated immature seals at Midway. In response to Gilmartin's suggestion, the Hawaiian Monk Seal Recovery Team recommended that a survey of diseases be conducted in immature age classes at FFS to preclude the possible transport of a new disease to the Midway population. At their previous meeting (December 1990) the Team had also recommended that potential prey species at Midway be tested to determine the possibility of ciguatera poisoning of relocated seals.

Seal relocation plans and concerns

To satisfy the Recovery Team's recommendation for disease screening, an investigation team, including Bill Gilmartin, veterinarian Dr. Bob Morris, and Doug Skilling (virology technician of Al Smith at OSU) visited FFS 9-10 April to examine and collect specimen materials from emaciated and normal juvenile monk seals. Blood and stool samples were taken from 19 immature animals for blood cell counts, serum chemistry profiles, and specific tests for canine distemper, caliciviruses, Leptospira, Salmonella, and gastrointestinal parasites (Appendix 1,2,3). No serum titers to canine distemper virus were detected, one seal had a low titer to Leptospira, and Salmonella bacteria were recovered from two seals. Immunoblot tests for calicivirus group antibodies were positive from most seals, but serum neutralizing tests for antibody and repeated culture attempts were negative. Stool samples revealed that all seals had varying loads of Contracaecum, Diphyllobothrium, and Anisakis gastrointestinal parasites. This information led to the conclusion that a disease epidemic was not contributing to the decline in immature seals at FFS.

In response to the Recovery Team's recommendation for ciguatera assessment, a survey of ciguatera levels in nearshore fishes at

5

Midway was completed in January 1992. Unfortunately, the results of this survey were inconclusive, as multiple tests of the same tissue gave inconsistent results. Many of the positive results were from larger predatory fishes that are not known to be monk seal prey. In addition, a large proportion of the tests gave borderline results. Finally, the Hokama stick test that was used in the survey is known to be conservative, with a bias toward false positives. It should be noted that there have been no observations of ciguatera poisoning of monk seals at Midway, and the beaches on the island are frequently monitored by U.S. Fish and Wildlife Service personnel stationed at Midway. Still, the extent to which ciguatera poisoning represents a threat to relocated animals remains somewhat uncertain.

In spite of this uncertainty, the decision was made to relocate animals in poor condition because the likelihood of continued starvation and death seemed imminently more threatening than the possibility of ciguatera poisoning at Midway. Collected seals were to be brought to Oahu for evaluation of any possible critical veterinary needs, individual disease screening, and initiation of feeding (estimated to be 2-4 weeks). These animals would then be taken to Midway for continued fattening and release as soon as they had gained weight and were deemed to be in good health. Rehabilitation at Midway was expected to require 1-2 months.

Collection and Rehabilitation Status

Seven thin to emaciated seals (aged 1-3) were collected at FFS and transported to Oahu, arriving on 7 May. They were taken to an isolated beach enclosure on the Marine Corps Air Station, Kaneohe Bay, Oahu, and attempts were made to feed them with herring. Seals not eating within the first two days were force fed herring until they began free feeding. The last seal was severely emaciated and sick with Pseudomonas pneumonia; this animal did not start free feeding until almost four weeks later. Five days after their arrival, samples were collected from the seals for the routine disease screening tests currently performed on all monk seals on arrival at Oahu and before reintroduction to the wild (Appendix 4).

The two males in the group, YZ15 (1-yr-old) and YG63 (2-yr-old), died on 16 and 17 May, respectively. Necropsies were performed by Dr. Dave MacKay and tissues were sent to California Veterinary Diagnostics, Inc. (CVD) for histopathologic evaluation (Appendix 5). Histopathology and bacterial cultures indicate the cause of death for YZ15 was a Pseudomonas pneumonia. The other seal, YG63, suffered severe pulmonary congestion and alveolar collapse with multifocal alveolar histiocytosis. These findings suggest that the lung pathology may have been associated with inhalation. On May 12, after YG63 was force-fed whole fish, he appeared very

weak and vomited a large volume of yellowish fluid. This incident could have resulted in the pneumonia. Serum from each of these two seals had shown low antibody titers to Leptospira sp. in samples collected on 12 May (Appendix 4). The significance of these findings will be discussed below.

Of the five remaining seals (all female), only one appeared to be highly compromised by disease. YZ67 had an elevated white blood cell count, presumably from an upper respiratory infection of Pseudomonas. Antibiotic sensitivity tests indicated Amikacin should be an effective treatment, and treatment was begun immediately. Later, all seals were treated with Amikacin due to their generally poor physical condition and the potential for stress-induced pneumonia.

From the end of May to the present, the general trend in individual blood counts, chemistry profiles (Appendix 4), and weights (indexed by monitoring girth) has been progression toward normal values. The single exception has been an apparent anemia in YZ67; she was treated with heptuna and zantac, and further blood tests are pending. Her other blood values are within normal limits and she appears to be gaining weight steadily.

Also, in spite of repeated treatments for Salmonella and gastrointestinal parasites, all five seals continue to harbor these endemic ailments. Neither condition appears to be causing any problems.

Disease Concerns

Leptospirosis

One of the 19 seals sampled at FFS in April showed a 1:200 titer to Leptospira (Appendix 3). Several of the juvenile seals collected at FFS in May for rehabilitation and reintroduction had low titers to Leptospira in assays performed by CVD and Cornell University (Appendix 4,6). The latter group of tests included the two juvenile male seals that died about one week after transport to Honolulu. While these two seals had low titers to Leptospira, no clinical, necropsy, or histopathology evidence of Leptospira infection was apparent in either seal.

Concern over the initial (albeit) low titers led to further testing, which was done at the Diagnostic Laboratory at Cornell University. All of the serum samples that had tested positive for Leptospira at CVD and the most recent negative samples were sent to Cornell. These samples included those from the two males that died in May. In addition, two samples were sent from animals that were found dead at FFS, and twenty samples were sent from adult males at Laysan Island (collected as part of another study). The Cornell laboratory found only one low titer in this

7

group of samples. Testing of subsequent samples by Cornell have shown a pattern of negative or 1:100 positive titers (the weakest indicator of experience with the serotype) to several Leptospira serotypes (Appendix 6).

Much discussion has evolved over the significance of these findings. The discussion has focused on three main issues. First, how should differing results from different tests of the same blood sample be interpreted. Second, how accurate are the tests; i.e., what are the rates of false positives and false negatives. And third, these tests are based on agglutination of Leptospira. At what level of apparent agglutination should a test be considered a true indicator of disease.

All three laboratories performed the Leptospira antibody assay by the same general procedure, a live culture microagglutination test. So, why the variation in results? According to Cornell University laboratory staff and Dr. Smith (OSU), the assay with the live organism is extremely "temperamental," requiring daily careful standardization of the antigen suspension for an accurate test - the implication here is that not all labs give the test sufficient attention in this regard. No common standards are used by all labs running the test to control for inter-lab differences.

The antigen used in these tests can easily auto-agglutinate (in the absence of specific antibody), giving false positive results. The generally accepted error in this (and other serial dilution antibody assays) is one dilution on either side of the "true" value. In other words, a serum specimen that is negative may occasionally test positive at the 1:100 dilution, or a known 1:100 serum may test positive at 1:200 or negative.

What is the significance of these low titers in regard to evidence of Leptospira infection? The Cornell University laboratory staff response to this question was that without supporting clinical data or pathological evidence, titers at this level could not be construed as evidence of infection. Another consideration here is that these tests also detect antibody which may be cross reacting from other organisms such as saprophytic Leptospira which may stimulate a titer in an animal, but are incapable of producing disease. In actual pinniped disease conditions, measured titers are higher than observed in the monk seals. Dr. Leslie Dierauf, who worked at the California Marine Mammal Center during a number of Leptospira epidemics in California sea lions, did not see an animal with Leptospira that didn't have a titer above at least 1:640. Dr. Al Smith, investigating the 1970 Leptospira epidemic in sea lions along the California coast, measured serum titers in 9 diseased animals. Eight of the seals showed 1:10,000 - 1:100,000 titers to the infecting Leptospira serotype, and one seal had a 1:1000 titer.

In view of the absence of other evidence of Leptospira infection, and the above findings, the low antibody titers measured in monk seals appear to be of no significance.

Endemic diseases in the wild

Since the investigation of the monk seal die-off at Laysan Island in 1978, which included sampling seals at other islands, Salmonella and gastrointestinal roundworms and tapeworms have been known to be endemic in the monk seal population. Over the years, both Salmonella and parasites have been difficult to clear from captive animals. Currently, the guidelines defined by the Captive Monk Seal Review Committee for releasing rehabilitated monk seals call for these endemic conditions to be successfully treated. Consequently, some animals destined for release have been held in captivity longer than anticipated, and some retreated many times in the attempt to clear these conditions. The additional maintenance time has led to more stress (rehandlings and retreatments) and increased program costs. In the case of seals being held for reintroduction (i.e., the five females currently at the Marine Corps Air Station), extending captive holding time can only increase the chance of the seals acquiring some non-endemic disease. Also, added maintenance is very costly due to the added time and expense required for repeatedly rearranging transport logistics.

A Navy sponsored workshop entitled "Exploring the Reintroduction of Captive Marine Mammals" was held in Albuquerque, New Mexico, in June of this year. It was attended by individuals with varied experience with both captive and wild marine mammals. The goal was to develop a plan which would provide the best opportunity for survival of animals released back into the wild. A document summarizing the recommendations of this workshop will be prepared. One working group considered the disease and genetic problems related to reintroduction (Sam Ridgway and Bill Gilmartin were among the participants). A few items of immediate concern to the monk seal rehabilitation/reintroduction program were discussed in this group; the results of these discussions suggest certain of the current guidelines for releasing monk seals should be reconsidered.

The issue of releasing marine mammals with conditions which may be endemic in the wild population was addressed. All participants agreed and recommended that animals should not be treated for conditions that they will probably reacquire when released into the wild population. The general belief was that released animals will most certainly reacquire such endemic maladies and releasing a "sterile" animal may in fact reduce its chance of survival. Perhaps worse, unless the treatments given are highly successful, the target organisms may develop drug

Appendix A.--Continued.

resistance which could then spread in the wild marine mammal population.

These findings suggest the Captive Monk Seal Review Committee should reconsider its requirement for treatment of gastrointestinal Salmonella and parasites prior to release.

Conclusions and recommendations

The FFS monk seal population continues to decline at a catastrophic rate. The decline appears to be due to an environmentally-related reduction in available food resources. No diseases have been identified in the population other than those known to be endemic or opportunistic (bacterial infections such as Pseudomonas pneumonias). The observed low resighting rate of immature seals and frequency of emaciated seals on the beaches at FFS deserves immediate attention.

The Midway Islands monk seal population is highly depleted. The decline of this population was probably due to human disturbance, but the disturbance has been significantly reduced in recent years. Furthermore, continued reductions in island staffing are expected in the near future. Food resources at Midway should be able to support a much larger seal population. Relocation of emaciated immature seals from FFS to Midway provides a way to bolster the Midway population with animals that are highly likely to be lost to the FFS population due to starvation. The success of this relocation strategy has already been demonstrated at Kure Atoll.

The first phase of this relocation operation was the collection of seals for veterinary evaluation and initial rehabilitation on Oahu. The five seals still being held on Oahu are gaining weight and should be transported to Midway as soon as possible for final processing and release (with the exception that YZ67 may require further monitoring and evaluation). Although the seals carry endemic Salmonella and gastrointestinal parasites, these conditions should not be treated further as they do not appear to be compromising the seals in any way.

Collections of emaciated seals should be continued at FFS, with the goal of relocation of these seals directly to Midway as soon as possible for rehabilitation and release. The costs and difficulties associated with the logistics supporting the rehabilitation effort at Midway is much preferred over FFS. Additionally, the Midway site offers a fringe benefit of having a weekly flight schedule to facilitate specimen transport and a small hospital laboratory available which could be of critical importance in monitoring the status of a sick animal. Based on our experience with the May seal collection, it seems advisable to begin a prophylactic antibiotic treatment regimen at the time

Appendix A.--Continued.

10

of collection and this should be defined prior to future collections.

Close monitoring of both FFS and Midway populations should be continued to evaluate survivorship of the released rehabilitated seals at Midway and to identify emaciated seals at FFS which may be candidates for relocation.

APPENDIXES TO APPENDIX A

Appendix A1. Blood counts, clinical chemistry, canine distemper serology, and size classifications of 19 immature seals

Appendix A2. Summary of parasite ova identified in fecal specimens from 19 monk seals

Appendix A3. Summary of viral and *Leptospira* serology conducted by Oregon State University on specimens from 19 monk seals

Appendix A4. Blood counts, clinical chemistry, *Leptospira* serology, *Salmonella* cultures, fecal parasite, *Salmonella* and parasite treatment schedules, calicivirus serology, canine distemper serology, and heartworm test results from Hawaiian monk seals collected

Appendix A5. Necropsy reports from two monk seals

Appendix A6. *Leptospira* serology conducted by Cornell University Diagnostic Laboratory on monk seals

Appendix A1.--Blood counts, clinical chemistry, canine distemper serology, and size classifications of 19 immature seals sampled at French Frigate Shoals in April 1992. Tests conducted by California Veterinary Diagnostics, Inc.

Test	Normal Mean	Normal Range	Date																		
				4-10-92	4-19-92	4-20-92	4-21-92	4-14-92	4-28-92	4-29-92	4-30-92	4-30-92	5-01-92	4-28-92	5-7	4-11-92	4-11-92	4-14-92	4-14-92	4-14-92	4-11-92	4-14-92
				10-72	7-23	12-41	6-02	12-15	12-47	12-31	2-58	12-45	12-46	12-59	12-35	12-11	12-17	12-18	12-65	12-29	16-74	12-67
WBC	8.8	(3.7-11.2)		6.0	3.5	9.0	3.4	4.2	6.9	3.4	6.1	5.6	8.9	8.0	3.2	6.3	9.4	5.6	8.0	10.4	6.6	7.4
SEG	49	(33-69)		26	62	52	61	55	60	40	50	50	72	41	55	48	66	48	41	73	34	44
BAND	1	(0-6)		1	0	1	0	2	0	0	0	0	1	0	1	0	0	0	0	1	0	0
LYMPH	41	(19-53)		51	27	32	33	35	30	33	31	40	19	35	27	31	17	38	52	19	37	43
MONO	6	(2-13)		4	2	5	4	5	6	10	6	4	5	8	5	4	6	1	5	2	5	3
EOSIN	3	(0-7)		18	9	10	1	3	4	16	13	6	3	15	12	13	11	13	2	5	24	10
BASO	0	(0-1)		0	0	0	1	0	0	1	0	0	0	1	0							
RBC	3.6	(3.1-4.3)		3.58	3.82	4.29	3.93	3.40	3.66	3.60	4.05	3.40	4.12	3.64	3.91	3.69	3.63	4.02	3.64	3.67	3.60	3.91
HGB	10.3	(10.3-21.0)		10.8	12.3	12.0	10.3	10.1	11.9	10.3	10.2	9.7	11.1	9.4	9.3	12.1	11.1	11.7	11.3	12.3	10.3	10.1
HCT	56.7	(44.2-61.3)		53.4	54.9	64.9	53.4	52.4	52.4	52.6	58.4	48.7	59.4	55.9	54.3	56.0	54.6	59.3	54.3	54.6	56.3	46.6
MCV	150.7	(137.3-161)		141	144	151	136	151	143	141	144	143	146	154	140	152	151	147	149	149	156	146
MCH	50.9	(47.1-56.4)		52.5	50.5	51.3	42.6	53.7	48.9	50.8	49.9	49.7	51.2	53.3	49.9	51.8	52.6	51.0	51.0	22.6	53.6	20.5
MCHC	33.7	(33.6-35.5)		35.2	35.1	33.9	35.0	35.7	34.2	34.8	34.6	34.7	35.2	34.7	35.8	34.1	35.0	34.6	35.2	35.4	34.3	34.6
Platelets	415	(323-527)		10E9	10E9	10E9	10E9	11E9	10E9	10E9	10E9	10E9	10E9	10E9	10E9	10E9	10E9	10E9	10E9	10E9	10E9	10E9
SGPT	58.5	(13-148)		136	127	93	102	167	214	142	90	115	89	115	118	135	141	73	88		166	87
SGOT	79.3	(9-163)		129	80	68	68	123	152	59	95	75	90	75	60	102	85	85	61		100	95
ALK. PHOS.	186.3	(75-521)		487	352	158	296	151	133	101	216	214	183	214	188	158	267	216	203		105	116
T. BILI.	0.3	(0.2-0.5)		0.1	0.1	0.1	0.1	0.2	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2		0.3	0.1
D. BILI	0.07	(0-0.1)		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0		0.1	0.0
T. PROTEIN	7.0	(5.8-8.1)		7.3	7.9	7.9	6.7	6.9	7.4	7.0	7.6	7.8	7.7	7.8	7.5	6.1	7.0	7.3	7.2		7.1	7.0
ALBUMIN	3.6	(2.6-3.6)		3.0	2.8	3.0	2.6	3.1	3.1	3.0	2.8	3.1	3.1	3.1	3.0	2.6	2.7	2.6	2.9		3.0	2.6
GLOBULIN	3.6	(3.0-4.5)		4.3	5.1	4.9	4.1	3.8	4.3	4.0	4.8	4.7	4.6	4.7	4.7	3.5	4.3	4.7	4.3		4.1	4.4
A/G RATIO																						
BUN	23.6	(9-34)		40	34	53	25	38	32	42	36	32	41	36	36	38	42	36	43		26	41
CREAT.	1.0	(0.5-1.7)		0.7	0.8	1.2	0.9	0.6	0.6	1.0	1.0	0.6	1.2	1.2	1.1	0.8	0.8	1.0	1.0		0.9	1.0
INORG. PHOS.	7.1	(4.3-9.3)		6.3	7.4	6.3	6.2	5.5	6.4	6.6	6.1	6.0	5.5	9.5	8.5	6.0	6.8	7.0	6.6		8.1	6.3
CALCIUM	11.0	(9.6-12.1)		10.1	9.8	11.1	9.4	9.6	10.1	10.3	10.2	10.6	11.3	10.9	10.1	10.5	10.8	10.7	10.3		10.3	10.2
Glucose	112.1	(88-133)		106	138	107	107	76	76	116	115	80	79	113	115	95	88	99	66		73	90
NA+	155	(150-164)		152	150	158	149	154	147	149	148	150	157	156	151	151	149	148	152		154	152
K+	5.5	(4.7-6.3)		5.3	4.9	5.9	5.2	4.8	5.2	5.4	4.3	5.2	5.7	5.9	4.8	5.0	4.5	4.9	4.6		4.9	4.9
CL-	106.8	(103-118)		106	103	105	106	107	105	108	105	—	103	102	103	110	107	106	106		104	107
TRIG	55.6	(28-91)																				
LDH	833	(442-1,344)																				
GGTP	7.9	(2-11)																				
CHOL	317.3	(187-568)		132	111	321	276	148	11	105	215	131	268	288	213	93	196	246	220		80	203
URIC ACID	1.5	(0.8-2.3)																				
CPK				984	493	651	692	810	2267	359	632	102	1127	123	81	538	503	335	394		218	1230
BICARB				15	20			18	21	19	14	23	19	17		18	15	15			23	
DISTEMPER IGG				ALL	NEG	NO	ANTIBODY	1:25								NEG	NEG	NEG	NEG		NEG	NEG
DISTEMPER IGM				ALL	NEG	NO	ANTIBODY	1:10								NEG	NEG	NEG	NEG		NEG	NEG
SALMONELLA FECAL																						
SEAL WEIGHT E=EMACIATED, T=THIN S=SMALL, N=NORMAL				T	N	N	N	TE	E	N	N	E	E	N	T	E	S	S	S	S	E	S

Appendix A2.--Summary of parasite ova identified in fecal specimens from 19 monk seals examined at French Frigate Shoals in April 1992.

Ocean Studies Institute

California State University
1250 Bellflower Boulevard
Long Beach, California 90840
(213) 985-5343

May 28, 1992

William Gilmartin
National Marine Fisheries Service
Southwest Fisheries Center
Honolulu Laboratory
2570 Dole Street
Honolulu, Hawaii 96822-2396

Dear Bill,

Under separate cover I am sending you prepared slides of the following samples. I have indicated the following parasites by number:

1 = Contracaecum (probably C. turgidum)
2 = Cestode (Diphyllobothrium sp. (It's nearly impossible to tell the species apart by eggs)
3 = Anisakis sp.

The infections were ranked:

1 = very heavy
2 = heavy
3 = medium
4 = light

YZ 18 - 1-*65%, 2-20%, 3-15% -3
YV 67 - 0 No eggs found. Sample consisted of one large chunk. I broke it up and made a suspension but still no eggs seen in sample.
YZ 11 - 1-95, 2-5 -4
YZ 17 1-90, 2-5, 3-5 -3
YZ 65 1-60, 2-35, 3-5 -3

* percentages are approximate

(see next page)

Appendix A2.--Continued.

YG 74	1-65, 2-30, 3-5	-3
YZ 29	1-65, 2-30, 3-5	-3
YG 99	1-35, 2-30, 3-35	-3
YZ 23	1-65, 2-20, 3-15	-1
YZ 44	1-30, 2-35, 3-35	-2
YG 02	1-70, 2-10, 3-20	-3
YZ 47	1-few, 2-few, 3-few	-4
YZ 56	1-70, 2-20, 3-10	-3
YZ 45	1-95, 2+3-5	-3/4
YZ 60	1-95, 2+3-5	-3/4
YZ 31	1-60, 2-5, 3-35	-3
YZ 58	1-70, 2-15, 3-15	-2
YZ 72	1-95, 2-3, 3-2	-3
YZ 15	1-97, 2-1, 3-2	-4

I told Bob Morris I would send some photographs so he would know what I am calling what. I saw a few trematode eggs but really insignificant. Also, I saw a few large egg-looking structures that are probably pollen. I have seen similar things in sea lions.

Let me know if you have any questions.

Best regards,

Murray Dailey, Ph.D.

Appendix A3.--Summary of viral and Leptospira serology conducted by Oregon State University on specimens from 19 monk seals collected at French Frigate Shoals in April 1992.

Serology performed at Oregon State University

Monk Seal Sera vs. 22 Calicivirus Serotypes, Canine Distemper, and Pinniped Rotavirus 222, and Leptospira

Virus Types	Monk Seal Numbers (seals sampled at FFS in April 1992)																		
	YG02*	Y211*	Y215*	Y217*	Y218*	Y223*	Y229*	Y231*	Y244*	Y245*	Y247*	Y255*	Y258*	Y259*	Y260*	Y265*	Y267*	YU72*	YG74*
SMSV-1	-	-	-	-	-			-	-	-	-	-	-		-	-		-	-
SMSV-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
SMSV-3	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-
SMSV-4	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-
SMSV-5	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-
SMSV-6	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-
SMSV-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMSV-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMSV-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMSV-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMSV-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMSV-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMSV-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMSV-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMSV-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMSV-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMSV-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cetacean CV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Walrus CV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
U-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feline F-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mink 20-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Canine Dist	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pinniped RV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
*CV Group	+	+	+	+	+	NC	+	+	+	NC	NC	NC	NC	NC	+	+	+	+	+

* Immunoblot test for Calicivirus Group Antibodies (SMSV 5, 7420) SMSV-1, SMSV-2, SMSV-7, 12/19 Retrovirus, SMSV-17, MV20-3, Rota 222
All sera tested positive (++ to +++) for walrus calicivirus 7420 and negative to all other antigens

** Sera screened at 1:10 for neutralizing antibodies and 1:50 for group antibodies

*** Sera screened at 1:50 and 1:200 against L. pomona, L. icterohaemorrhagiae, L. hardjo and L. grippotyphosa all were negative except Sera YG74 agglutinated at 1:200 with L. canicola. This is thought to be a spurious result and is being repeated.

Appendix A4

Blood counts, clinical chemistry, *Leptospira* serology, *Salmonella* cultures, fecal parasite, *Salmonella* and parasite treatment schedules, calicivirus serology, canine distemper serology, and heartworm test results from Hawaiian monk seals collected at French Frigate Shoals in May and proposed for relocation to Midway Islands

Most of the information in this appendix is summarized in the text of the report, however a brief account of the patterns observed in some individuals will be presented here.

Of the five females proposed for final processing for transport to Midway and release one (YU58) is a three year old, the other four (YZ--) are yearlings. All five seals are eating well and have gained weight. Behaviorally, they are all alert and, with the exception of YZ67, do not appear to have any problems suggesting that they would not be good candidates for release. YZ67 appears to have some degree of visual impairment in her left eye which must be further evaluated in the prerelease enclosure. She must demonstrate the ability to catch prey in quantity comparable to the other yearlings. Failing this, she will have to be returned to permanent captivity.

Three seals, YZ54, YZ60, and YZ65, have shown good blood cell pictures since their capture, with the exception of a short term infection, successfully resolved, in YZ60. She evidenced increased band neutrophils on 5/22, then an increased white cell count on 5/30. YZ60 was treated with antibiotics after the 5/22 finding and the count returned to within normal range by the 6/5 sampling. In her more recent blood samples, YZ54 has increased eosinophils. This cell is one of the enigmas of marine mammal medicine compared to terrestrial mammals. High counts, or for some species, any count at all, are taken to indicate parasite infection. Marine mammals, however, in captivity for many years without parasites, maintain eosinophil counts. YZ54 has gastrointestinal parasites and an expected elevated eosinophil count which has recently increased. The significance of this change is unknown, but probably of no consequence relative to her probability of survival in the wild.

A general trend down in red blood cell counts, as seen in each of these three seals, is usually observed in any marine mammal coming into captivity. This change appears to be a normal adjustment to the reduced physical demands related to feeding on the captive animal. Nothing unusual appears in the chemistry profiles of these seals that may be indicative of health problems.

Appendix A4.--Continued.

15

Seal YU58 has maintained a good white blood cell and serum chemistry picture throughout her captive history. Her red cell count data have also been normal, with the exception of the last sampling (7/1) in which the cell count, hemoglobin, and hematocrit are all substantially reduced. With other red cell indicators normal, the changes stated above may have been due to a sampling problem, such as a clot in the collecting tube. She will be resampled to check the red cell values again.

The only apparent persistent problem which has not been resolved to date is the declining red blood counts of YZ67. While some drop in these values were expected, her counts continue to decline and are now below the values usually experienced in captive monk seals. She is currently receiving treatments to bolster her blood counts. This condition warrants continued monitoring and treatment as determined appropriate. At the first examination and sampling of the seal after arrival on Oahu, an upper respiratory infection was apparent and antibiotic treatment was initiated. When culture results were received from the laboratory and a Pseudomonas was determined to be the cause, the antibiotic therapy was altered accordingly. The condition was finally resolved, as evidenced in her white cell counts after 5/22. Since then, she has steadily improved in all regards, with the exceptions of the red cell counts and eyesight, both mentioned above.

Appendix A4.--Continued.

MAKAI ANIMAL CLINIC

420 ULUNIU STREET
KAILUA, HAWAII 96734
ROBERT A. MORRIS, D.V.M. PHONE: 262-9621

LEPTO SUMMARY (CVD)

	5/12/92	5/13/92	6/12/92
4Z-15	1:400 1:1600	DIED	
4Z-63	1:200	DIED	
4Z 67	1:100	neg	neg
4Z-60	neg	neg	
4Z-65	neg	1:100	
4Z-54	neg	neg	
YU-58	neg	neg	

SALMONELLA SUMMARY

	FF SHORES 4/92	MARINE BASE 5/20		6/11
4Z-15	neg	POS	DIED	
4Z-63	—	POS	DIED	
4Z 67	neg	POS	not submitted	POS
4Z-60	POS	neg	neg	POS
4Z-65	neg	POS	POS	POS
4Z-54	—	POS	POS	POS
YU-58	—	neg	POS	POS

ARRIVAL - 5 OF 7 POS
5/20 - 3 OF 4 POS
6/11 - 5 OF 5 POS

ABOVE TREATED WITH ANTIBIOTICS + NOT CULTURED - CARRIER ANIMALS ?

Appendix A4.--Continued.

MAKAI ANIMAL CLINIC
420 ULUNIU STREET
KAILUA, HAWAII 96734
ROBERT A. MORRIS, D.V.M. PHONE: 262-9621

PARASITE SUMMARY

ALL ON ARRIVAL SHOWING NEMATODES (ROUNDS) AND CESTODES (TAPES)—

WORMED 5/12/92

WORMED AGAIN BY BILL CUMMINGS WHILE I WAS AWAY MAY 16-29 DATE ?

FECALS-5/30 - STILL SHOWED PERSISTANT TAPES & ROUNDS

6/15 - WORMED ALL AGAIN WITH DIFFERENT WORM RI

6/25 - STOOL SAMPLES - MILD TO MODERATE # OF OVA (ROUNDS & TAPES) SHOWING IN STOOL.

PLAN ON REWORMING ALL AGAIN

Appendix A4.--Continued.

MAKAI ANIMAL CLINIC
420 ULUNIU STREET
KAILUA, HAWAII 96734
ROBERT A. MORRIS, D.V.M. PHONE: 262-9621

HEALTH SCREEN RESULTS

ALL ~~HSC~~ ON 1) TOXO TITERS
2) OCCULT HEARTWORM
3) PARVO TITERS

BLOOD SCREEN —
MINOR PROBLEMS RESOLVED

YZ-67 — OBSERVATIONS INDICATE NOT A NORMAL ANIMAL
PERSISTANT ANEMIA SINCE 6/5/92 — HAS BEEN TREATED BUT NOT RESOLVED —

YZ-54 — PERSISTANT HIGH EOSINOPHIL COUNT — INDICATES PARASITIS BUT DOES NOT SHOW (HEAVY) INFECTION IN STOOL.

YZ-60 — SLIGHT ANEMIA ON LAST SCREEN (7/1/92) — HCT
SOME INDICATION OF INFECTION 5/22 & 5/30 BUT RESOLVED WITH TREATMENT.

YU-58 — SHOWING ANEMIA ON LAST SCREEN 7/1/92

Appendix A4.--Continued.

I.D. No. YU-58
NAME:

HEMATOLOGY AND SERUM CHEMISTRY
LABORATORY ANALYSIS RESULTS

Test	Normal Mean	Normal Range	Site	Date 5/12/97	5/15/97	5/22/97	9/3/97			
WBC	8.8	(5.7-11.2)		7.1	5.3	6.0	5.0			
SEG	49	(33-69)		70	64	77	365			
BAND	1	(0-6)		2	1					
LYMPH	41	(19-52)		14	18	13	19			
MONO	6	(2-13)		1	1	4	10			
EOSIN	2	(0-7)		12	15	5	6			
BASO	0	(0-1)			1	1				
RBC	3.6	(3.1-4.3)		2.40	3.40	3.54	3.25			
HGB	18.5	(14.5-21.8)		15.4	14.3	15.9	12.2			
HCT	54.7	(44.2-61.3)		48.9	46.6	52.3	50.4			
MCV	150.7	(137.3-167)		144	142	148	155			
MCH	50.9	(47.1-54.4)		54.1	52.9	50.4	52.9			
MCHC	33.7	(32.6-35.5)		37.7	32.1	36.1	34.1			
Platlets	415	(323-527)		ADEQ	ADEQ	ADEQ	ADEQ			
SGPT	58.5	(13-148)		67	50	74	47			
SGOT	79.5	(9-163)		61	42	57	34			
ALK. PHOS.	186.2	(75-521)		66	46	71	53			
T. BILI.	0.3	(0.2-0.5)		0.4	0.5	0.3	0.3			
D. BILI	0.07	(0-0.1)		0.0	0.0	0.1	0.1			
T. PROTEIN	7.0	(5.8-8.1)		8.6	8.2	8.2	7.2			
ALBUMIN	3.4	(2.4-3.4)		3.2	3.2	3.0	2.5			
GLOBULIN	3.6	(3.0-4.5)		5.4	5.0	5.2	4.4			
A/G RATIO				0.6	0.6	0.6	0.6			
BUN	23.6	(9-34)		16	26	22	24			
CREAT.	1.0	(0.5-1.7)		0.6	0.4	0.5	0.7			
INORG. PHOS.	7.1	(4.3-9.3)		5.9	5.4	5.5	5.7			
CALCIUM	11.0	(9.4-12.1)		9.6	8.7	9.4	9.1			
Glucose	112.1	(88-133)		102	120	96	130			
NA+	155	(150-164)		149	153	155	157			
K+	5.5	(4.7-6.3)		4.2	4.6	4.6	5.2			
CL-	106.8	(103-118)		106	103	115	123			
TRIG	55.4	(28-91)								
LDH	832	(442-1,544)								
GGTP	7.9	(2-13)								
CHOL.	317.3	(187-568)		126	134	132	151			
URIC ACID	1.5	(0.8-2.3)								
CPK				1268	962	1259	269			
[illegible]				26	21	22				
[illegible]				24			205			
[illegible]				NEG			NEG			
SEAL WEIGHT				[illegible]						

Appendix A4.--Continued.

I.D. No. YZ-65
NAME:

HEMATOLOGY AND SERUM CHEMISTRY
LABORATORY ANALYSIS RESULTS

Test	Normal Mean	Normal Range	Site	Date	4/14/92	4/28/92	5/18/92	5/24/92	5/31/92
WBC	8.8	(5.7-11.2)			8.0	7.7	5.4	5.7	5.8
SEG	49	(33-69)			41	62	65	73	63
BAND	1	(0-6)			0				2
LYMPH	41	(19-52)			52	29	24	14	14
MONO	6	(2-13)			5	4	9	8	13
EOSIN	2	(0-7)			2	5	2	5	7
BASO	0	(0-1)							1
RBC	3.6	(3.1-4.3)			3.64	3.85	3.49	3.26	3.06
HGB	18.5	(14.5-21.8)			19.2	19.7	17.9	16.8	15.9
HCT	54.7	(44.2-61.3)			54.2	54.9	50.5	47.6	45.6
MCV	150.7	(137.3-167)			149		144	146	149
MCH	50.9	(47.1-54.4)			52.8	51.2	51.2	51.5	52.0
MCHC	33.7	(32.6-35.5)			35.5	35.9	35.5	35.2	34.9
Platlets	415	(323-527)			NL	ADEQ	ADEQ	ADEQ	
SGPT	58.5	(13-148)			58	62	66	56	46
SGOT	79.5	(9-163)			161	169	126	142	129
ALK. PHOS.	186.2	(75-521)			202	125	140	153	215
T. BILI.	0.3	(0.2-0.5)			0.2	0.2	0.1	0.1	0.1
D. BILI	0.07	(0-0.1)			0.0	0.1	0.1	0.0	0.0
T. PROTEIN	7.0	(5.8-8.1)			7.2	7.5	7.4	7.0	6.7
ALBUMIN	3.4	(2.4-3.4)			2.9	3.2	3.2	2.9	3.0
GLOBULIN	3.6	(3.0-4.5)			4.2	4.2	4.1	4.1	3.8
A/G RATIO						0.8	0.8	0.7	
BUN	33.6	(9-34)			42	31	34	22	20
CREAT.	1.0	(0.5-1.7)			1.2	0.9	1.0	0.7	0.7
INORG. PHOS.	7.1	(4.3-9.3)			6.6	6.8	5.9	5.5	6.2
CALCIUM	11.0	(9.4-12.1)			10.3	10.2	9.4	9.2	9.5
Glucose	112.1	(88-133)			106	127	92	91	127
NA+	155	(150-164)			152	155	152	152	148
K+	5.5	(4.7-6.3)			4.6	4.7	4.6	4.4	4.2
CL-	106.8	(103-118)			106	113	114	114	116
TRIG	55.4	(28-91)							
LDH	832	(442-1,544)							
GGTP	7.9	(2-13)							
CHOL.	317.3	(187-568)			220	162	154	168	151
URIC ACID	1.5	(0.8-2.3)							
CPK					87.5	2640	1729	1112	472
[illegible]						27	21	31	
[illegible]									
[illegible]						pos			pos
[illegible]						neg			pos 1.04
[illegible]									
SEAL WEIGHT									
FINAL									

Appendix A4.--Continued.

I.D. No. YZ-60
NAME:

HEMATOLOGY AND SERUM CHEMISTRY
LABORATORY ANALYSIS RESULTS

Test	Normal Mean	Normal Range	Site	Date 4/10/92	5/12/92	5/15/92	5/22/92	5/31/92	6/4/92	6/24/92
WBC	8.8	(5.7-11.2)		5.9	7.4	7.2	6.2	12.3	4.1	5.9
SEG	49	(33-69)		72	67	72	41	75	62	65
BAND	1	(0-6)		1		1	17	1		
LYMPH	41	(19-52)		19	27	19	22	9	31	21
MONO	6	(2-13)		5	3	7	12	10	3	12
EOSIN	2	(0-7)		3	2	1	8	2	4	11
BASO	0	(0-1)		0	1					
RBC	3.6	(3.1-4.3)		4.12	3.84	3.27	3.55	3.16	2.80	2.60
HGB	18.5	(14.5-21.8)		21.1	19.5	17.9	18.1	16.0	14.9	15.2
HCT	54.7	(44.2-61.3)		59.9	53.5	47.6	51.7	45.4	38.8	39.7
MCV	150.7	(137.3-167)		146	139	141	141.0	144	144	141
MCH	50.9	(47.1-54.4)		51.2	50.8	52.8	51	50.6	54.4	52.9
MCHC	33.7	(32.6-35.5)		35.2	36.5	37.4	35	35.2	38.7	36.6
Platlets	415	(323-527)		ADQ	ADQ	ADQ	ADQ	ADQ	ADQ	
SGPT	58.5	(13-148)		89	72	56		45		
SGOT	79.5	(9-163)		90	64	26		291		
ALK. PHOS.	186.2	(75-521)		147	122	153		235		
T. BILI.	0.3	(0.2-0.5)		0.1	0.2	0.0		0.1		
D. BILI	0.07	(0-0.1)		0.0	0.0	0.0		0.0		
T. PROTEIN	7.0	(5.8-8.1)		7.7	7.6	7.2		5.9		
ALBUMIN	3.4	(2.4-3.4)		3.1	3.5	3.3		2.6		
GLOBULIN	3.6	(3.0-4.5)		4.6	4.1	3.9		3.3		
A/G RATIO					0.9	0.8		0.8		
BUN	13.6	(9-34)		17	35	24		30		
CREAT.	1.3	0.5-1.3		1.2	1.3	0.8		0.8		
INORG. PHOS.	7.1	(4.3-9.3)		6.6	7.1	5.0	5.0	6.7		
CALCIUM	11.0	(9.4-12.1)		11.3	10.1	9.9	9.5	9.4		
Glucose	112.1	(88-133)		79	105	105		127		
NA+	155	(150-164)		157	154	156		152		
K+	5.5	(4.7-6.3)		5.7	4.7	4.0		5.0		
CL-	106.8	(103-118)		103	106	111		120		
TRIG	55.4	(28-91)								
LDH	832	(442-1,544)								
GGTP	7.9	(2-13)								
CHOL.	317.3	(187-568)		366	191	154		142		
URIC ACID	1.5	(0.8-2.3)								
CPK				1127	2937	437		279		
13 (Carnus				19	23	28		24		
[illegible]										
SALmonella					neg			neg		
LEPTO					neg			neg		
SEAL WEIGHT										
FECAL										

Appendix A4.--Continued.

I.D. No. YZ-54
NAME:

HEMATOLOGY AND SERUM CHEMISTRY
LABORATORY ANALYSIS RESULTS

Test	Normal Mean	Normal Range	Site	Date 5/12/92	5/15/92	5/22/92	5/29/92
WBC	8.8	(5.7-11.2)		7.7	11.5	9.8	8.7
SEG	49	(33-69)		61	76	66	62
BAND	1	(0-6)		5			2
LYMPH	41	(19-52)		16	11	12	29
MONO	6	(2-13)		6		5	5
EOSIN	2	(0-7)		12	13	12	23
BASO	0	(0-1)				5	
RBC	3.6	(3.1-4.3)		3.37	3.28	3.2	3.05
HGB	13.5	(14.5-21.8)		16.2	14.4	11.20	15.0
HCT	54.7	(44.2-61.3)		42.0	41.2	42.9	43.9
MCV	150.7	(137.3-167)		124	125	129	141
MCH	50.9	(47.1-54.4)		45.4	44.1	48.5	49.21
MCHC	33.7	(32.6-35.5)		36.2	35.9	34.9	34.0
Platlets	415	(323-527)		ADEQ	ADEQ	ADEQ	
SGPT	58.5	(13-148)		22	20	40	30
SGOT	79.5	(9-163)		12	23	36	20
ALK. PHOS.	186.2	(75-521)		119	121	141	165
T. BILI.	0.3	(0.2-0.5)		0.2	0.1	0.0	0.2
D. BILI	0.07	(0-0.1)		00	00	00	00
T. PROTEIN	7.0	(5.8-8.1)		6.4	7.1	7.5	6.5
ALBUMIN	3.4	(2.4-3.4)		2.6	3.2	3.5	3.4
GLOBULIN	3.6	(3.0-4.5)		3.8	3.9	4.0	3.9
A/G RATIO				0.8	0.8	0.9	0.9
BUN	12.5	(3-24)		9	14	12	11
CREAT.	1.0	(0.5-1.3)		0.6	0.5	0.5	0.5
INORG. PHOS.	7.1	(4.3-9.3)		6.3	6.0	6.2	6.1
CALCIUM	11.0	(9.4-12.1)		9.3	9.0	9.1	9.6
Glucose	112.1	(88-133)		87	92	104	129
NA+	155	(150-164)		153	154	154	152
K+	5.5	(4.7-6.3)		4.2	4.6	4.4	5.1
CL-	106.8	(103-118)		117	115	118	114
TRIG	55.4	(28-91)					
LDH	832	(442-1,544)					
GGTP	7.9	(2-13)					
CHOL.	317.3	(187-568)		144	142	122	144
URIC ACID	1.5	(0.8-2.3)					
HCT				2028	1664	1007	1330
WBC				25	30	30	31
MCHC				NEG			
CALCIUM				POS			POS
UREA				NEG			NEG
				0			0
SEAL WEIGHT FECAL				WNL			SAMPLE TOO SMALL

Appendix A4.--Continued.

I.D. No. Y3-67
NAME:

HEMATOLOGY AND SERUM CHEMISTRY
LABORATORY ANALYSIS RESULTS

FF Shows.

Test	Normal Mean	Normal Range	Site	Date 4/14/92	5/12/92	5/18/92	5/22/92	5/26/92	6/15/92
WBC	8.8	(5.7-11.2)		7.4	11.1	15.8	7.9	6.2	15.1
SEG	49	(33-69)		44	82	90	75	64	62
BAND	1	(0-6)		0	1				
LYMPH	41	(19-52)		42	10	4	17	18	32
MONO	6	(2-13)		2	7	4	2	13	3
EOSIN	2	(0-7)		10			2	3	3
BASO	0	(0-1)						2	
RBC	3.6	(3.1-4.3)		3.19	3.61	2.58	2.23	2.43	2.90
HGB	18.5	(14.5-21.8)		16.1	19.7	17	16.8	17.3	14.1
HCT	54.7	(44.2-61.3)		46.6	51.6	42<	46.8	44.5	41.8
MCV	150.7	(137.3-167)		146	142	144	121	142	144
MCH	50.9	(47.1-54.4)		50.5	51.5	50.3	52.0	50.4	51.4
MCHC	33.7	(32.6-35.5)		34.6	36.3	36	34.4	35H	35.7
Platlets	415	(323-527)		ADEQ	ADEQ	ADEQ	ADEQ		ADEQ
SGPT	58.5	(13-148)		87	49	55	60	120	
SGOT	79.5	(9-163)		95	58	57	76	87	
ALK. PHOS.	186.2	(75-521)		116	83	83	56	100	
T. BILI.	0.3	(0.2-0.5)		0.1	0.3	0.2	0.6	0.2	
D. BILI	0.07	(0-0.1)		0.0	0.2	0.1	0.0	0.0	
T. PROTEIN	7.0	(5.8-8.1)		7.0	7.1	7.1	7.2	6.5	
ALBUMIN	3.4	(2.4-3.4)		3.6	3.5	3.5	3.6	3.5	
GLOBULIN	3.6	(3.0-4.5)		4.4	4.2	4.6	4.1	4.0	
A/G RATIO						0.8	0.8	0.9	
BUN	23.6	(9-34)		41	15	21	28	39	
CREAT.	1.0	(0.5-1.7)		1.0	0.6	0.5	0.4	0.6	
INORG. PHOS.	7.1	(4.3-9.3)		6.2	6.2	6.4	4.3	5.8	
CALCIUM	11.0	(9.4-12.1)		10.2	9.6	9.2	10.2	12.6	
Glucose	112.1	(88-133)		90	110	151	82	113	
NA+	155	(150-164)		157	155	152	152	155	
K+	5.5	(4.7-6.3)		4.9	4.7	4.1	4.4	5.7	
CL-	106.8	(103-118)		107	105	110	111	103	
TRIG	55.4	(28-91)							
LDH	832	(442-1,544)							
GGTP	7.9	(2-13)							
CHOL.	317.3	(187-568)		203	156	59	165	145	
URIC ACID	1.5	(0.8-2.3)							
CPK				12387	399	491	1592	1091	
MICRO					29	27	24	32	
CHLAMYDIA					DCS				
LYMPH					pos			neg	
					1:100				
					SOLID				
SEAL WEIGHT				100	111			NO SEAL	
FECAL									

Appendix A5.--Necropsy reports from two monk seals which were collected at French Frigate Shoals in May 1992 and died after arrival at Oahu.

CVD
FORNIA VETERINARY DIAGNOSTICS, INC.
(800) 444-4210 (916) 372-4200
P.O. Box V
3911 West Capitol Avenue
West Sacramento, CA 95691

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NANCY WILLIAM DVM MS CLINICAL PATHOLOGY

Accession: P215495-5
Date: May 22, 1992
Doctor: Morris
Clinic: U.S. Dept. Of Commerce
NOAA, NMFS, Honolulu Lab.
2570 Dole St.
Honolulu, HI 96822-2396

Client: Nat. Marine
Name: YZ15
Species: Hawaiian Monk Seal
Sex: Male
Age: 1 yr.

CLINICAL HISTORY: None given.

NECROPSY RESULTS: The intestinal lining appeared to be inflamed. The liver was mottled and yellow. Superficial stomach ulcers were noted. There was pulmonary edema. The pancreas appeared to be hemorrhagic.

HISTOLOGY: Submitted are multiple sections of tissue.

Heart: No lesion recognized.

Liver: Hepatocytes are variably swollen and vacuolated. A variable amount of hemosiderin is seen in Kupffer cells.

Kidney: No lesion recognized.

Stomach: An area of focal mucosal necrosis is present. Within this focus are fragments of what may be parasitic structures, although the morphology is not well-defined. Bacteria are also noted. A variable inflammatory lesion is seen that includes giant cells, neutrophils, macrophages and plasma cells.

Small intestine: No lesion recognized.

Spleen: Diffuse congestion is present.

Pancreas: There is moderate congestion.

Lung: Diffuse severe congestion and alveolar collapse are noted.

Lymph node: No lesion recognized.

CONTINUED

Appendix A5.--Continued.

CVD
LIFORNIA VETERINARY DIAGNOSTICS, INC.
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P.O. Box V
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CLINICAL PATHOLOGY

P215495-5 Page Two

DIAGNOSIS:

1. DIFFUSE MODERATE VACUOLAR HEPATOPATHY
2. DIFFUSE MILD HEMOSIDEROSIS - LIVER
3. DIFFUSE SEVERE PULMONARY CONGESTION AND ALVEOLAR COLLAPSE
4. MULTIFOCAL TO DIFFUSE MODERATE GASTRITIS

COMMENT: The exact cause of the gastric lesion is not determined. There does appear to be a bacterial infection, however, whether this primary or secondary to a parasitic problem is difficult to determine. Some fragments of material present are suggestive of the possibility of parasites, but certainly are not confirmatory. The acute pulmonary collapse could be the cause of death; however, the pathogenesis is not determined. No evidence of infection was seen in the lungs and the lesion may represent cardiovascular collapse or some type of inhaled irritant.

ROBERT E. SCHMIDT, DVM, PhD
Diplomate, American College
of Veterinary Pathologists

RES:cem

Appendix A5.--Continued.

CVD
CALIFORNIA VETERINARY DIAGNOSTICS, INC.
(800) 444-4210 (916) 372-4200
P.O. Box V
3911 West Capitol Avenue
West Sacramento, CA 95691

WILLIAM L. SPANGLER DVM PhD
ANATOMICAL PATHOLOGY
ROGER CULBERTSON DVM PhD
ANATOMICAL PATHOLOGY
ROBERT E. SCHMIDT DVM PhD
ANATOMICAL PATHOLOGY
ROBERT M. DUFORT DVM
CLINICAL PATHOLOGY
THELMA LEE GROSS DVM
ANATOMICAL PATHOLOGY
SONJA M. SHELLY DVM
CLINICAL PATHOLOGY
NOEL O. DYBDAL DVM PhD
ANATOMICAL PATHOLOGY
NANCY WILLIAM DVM MS
CLINICAL PATHOLOGY

P215494-6 Page Two

COMMENT: The gastric lesion noted is similar to that seen in a previous Monk Seal; however, in this case, well defined nematodes are present. The presence of these nematodes has caused a considerable amount of inflammation and certainly severe parasitism may have lead to inanition. The pulmonary lesion appears to be acute and may be associated with inhalation; however, the exact cause is not determined.

ROBERT E. SCHMIDT, DVM, PhD
Diplomate, American College
of Veterinary Pathologists

RES:cem

Appendix A5.--Continued.

CVD
IFORNIA VETERINARY DIAGNOSTICS, INC.
(800) 444-4210 (916) 372-4200
P.O. Box V
3911 West Capitol Avenue
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WILLIAM L. SPANGLER DVM PhD ANATOMICAL PATHOLOGY
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ROBERT M. DUFORT DVM CLINICAL PATHOLOGY
THELMA LEE GROSS DVM ANATOMICAL PATHOLOGY
SONJA M. SHELLY DVM CLINICAL PATHOLOGY
NOEL O. DYRDAL DVM PhD ANATOMICAL PATHOLOGY
NANCY WALUM DVM MS CLINICAL PATHOLOGY

Accession: P215494-6
Date: May 22, 1992
Doctor: Morris
Clinic: U.S. Dept. Of Commerce
NOAA, NMFS, Honolulu Lab.
2570 Dole St.
Honolulu, HI 96822-2396

Client: Nat. Marine
Name: YG63
Species: Hawaiian Monk Seal
Sex: Male
Age: 2 yrs.

CLINICAL HISTORY: Emaciated seal. No significant lesion noted grossly.

HISTOLOGY: Submitted are multiple sections of tissue.

Lung: There is diffuse pulmonary congestion and alveolar collapse. Large macrophages with foamy cytoplasm are seen in alveoli.

Lymph node: The node appears to be moderately reactive.

Liver: No lesion recognized.

Heart: No lesion recognized.

Brain: No lesion recognized.

Kidney: No lesion recognized.

Pancreas: No lesion recognized.

Stomach: Numerous nematodes are present within the mucosa and the lumen. There is a considerable amount of necrosis and inflammation associated with the lesion and througnout the section.

Adrenal gland: No lesion recognized.

Spleen: No lesion recognized.

DIAGNOSIS:

1. MODERATE TO SEVERE FOCAL TO DIFFUSE CHRONIC ACTIVE GASTRITIS
2. DIFFUSE SEVERE PULMONARY CONGESTION AND ALVEOLAR COLLAPSE
3. MULTIFOCAL ALVEOLAR HISTIOCYTOSIS - LUNG

CONTINUED

Appendix A6.--Leptospira serology conducted by Cornell University Diagnostic Laboratory on monk seals from French Frigate Shoals, Laysan Island 1992, and the 5 seals currently in rehabilitation.

Diagnostic Lab

Bacteriology Report

Accession number: 658221

Owner: NATIONAL MARINE FISHERY SERV

Diagnostic Laboratory • New York State College of Veterinary Medicine / P.O. Box 786 / Ithaca, N.Y. 14851-0786 / (607) 253-3333

Leptospira Serology (MAT)

No	IDENTIFICATION/ SPECIES	LEPTOSPIRA SEROTYPES														
		POM	HAR	ICT/CI	GRI	CAN	BAL	WOL	AUT	BAT	TAR	AUS	PYR	BRA	SEJ	ICT/I	JAV	SZW
1	Y458	–	–	–	–	–	EFS rehab 5/92											
2	Y215	–	–	–	–	1/100	EFS rehab - died 5/92 POST MORTEM											
3	Y260	–	–	–	–	–	EFS rehab 5/92											
4	T57M	–	–	–	–	–	LAYSAN SEAL – 1992											
5	TL58	–	–	–	–	–				"								
6	T45	–	–	–	–	–				"								
7	TT56	–	–	–	–	–				"								
8	T719	–	–	–	–	–				"								
9	TN00	–	–	–	–	–				"								
20	Y322	–	–	–	–	–				"								

NOTE: All samples screened at a final dilution of 1/100; therefore "–" = negative at 1/100 unless otherwise indicated.

POM *L. pomona* — HAR *L. hardjo* — ICT/C *L. icterohaemorrhagiae / copenhageni* — GRI *L. grippotyphosa* — CAN *L. canicola* — BAL *L. ballum*

WOL *L. wolffi* — AUT *L. autumnalis* — BAT *L. bataviae* — TAR *L. tarassovi (mitis, hyos)* — AUS *L. australis* — PYR *L. pyrogenes*

BRA *L. bratislava* — SEJ *L. seiroe* — ICT/I *L. icterohaemorrhagiae / icterohaemorrhagiae* — JAV *L. javanica* — SZW *L. szwajizak*

☑ Please forward a second serum sample in 2-3 weeks. Refer to the above accession number. SAMPLE #12

☐ A titer of 1/1600 or above for any one serotype is suggestive of recent infection with that serotype in the absence of recent vaccination for leptospirosis.

☐ A significant increase / decrease in titer has been noted for L. _____ on sample # _____, indicative of recent infection in the absence of recent vaccination for leptospirosis.

☐ It is unlikely that these results are significant.

☐ These results suggest recent vaccination for leptospirosis.

☐ These results suggest exposure to L. _____ at some time in the past.

☐ The above serum sample(s) was / were tested by microscopic agglutination for the serotypes indicated and found to be negative at: _____

☐ Sample(s) tested in parallel with previously submitted specimen(s). See (accession # _____).

COMMENTS

Date: 6/30/92 JS

Authorized by: _____

Appendix A6.--Continued.

Diagnostic Lab
Bacteriology Report

Accession number: 658221

Owner: NATIONAL MARINE FISHERY SER

Diagnostic Laboratory / New York State College of Veterinary Medicine / P.O. Box 786 / Ithaca, N.Y. 14851-0786 / (607) 253-3333

Leptospira Serology (MAT)

No	IDENTIFICATION/ SPECIES	LEPTOSPIRA SEROTYPES															
		POM	HAR	ICT/C	GRI	CAN	BAL	WOLI	AUT	BAT	TAR	AUS	PYR	BRA	SEJ	ICT/I	JAV	SZW
3	T424	—	—	—	—	—	Laysan Seal - 1992											
2	T349	—	—	—	—	—			"									
1	T439	—	—	—	—	—			"									
4	Y211	—	—	—	—	—	FFS death early 1992											
5	Yu15	—	—	—	—	—				"								
6																		
7																		
8																		
9																		
0																		

NOTE. All samples screened at a final dilution of 1/100; therefore "-" = negative at 1/100 unless otherwise indicated.

POM *L. pomona*
HAR *L. hardjo*
ICT/C *L. icterohaemorrhagiae / copenhageni*
GRI *L. grippotyphosa*
CAN *L. canicola*
BAL *L. ballum*
WOL *L. wolffi*
AUT *L. autumnalis*
BAT *L. bataviae*
TAR *L. tarassovi (mitis, hyos)*
AUS *L. australis*
PYR *L. pyrogenes*
BRA *L. bratislava*
SEJ *L. seiroe*
ICT/I *L. icterohaemorrhagiae / icterohaemorrhagiae*
JAV *L. javanica*
SZW *L. szwajzax*

- [x] Please forward a second serum sample in 2-3 weeks. Refer to the above accession number. SAMPLE #12
- [ ] A titer of 1/1600 or above for any one serotype is suggestive of recent infection with that serotype in the absence of recent vaccination for leptospirosis.
- [ ] A significant increase / decrease in titer has been noted for L. _____ on sample # _____ indicative of recent infection in the absence of recent vaccination for leptospirosis.
- [ ] It is unlikely that these results are significant.
- [ ] These results suggest recent vaccination for leptospirosis.
- [ ] These results suggest exposure to L. _____ at some time in the past.
- [ ] The above serum sample(s) was / were tested by microscopic agglutination for the serotypes indicated and found to be negative at: _____
- [ ] Sample(s) tested in parallel with previously submitted specimen(s). See (accession # _____)

COMMENTS

JUN 3 1 1992

Date: 6/30/92 JS

Authorized by: _____

Appendix A6.--Continued.

Diagnostic Lab
Bacteriology Report

Accession number: 658221

Owner: NATIONAL MARINE FISHERY SER

Diagnostic Laboratory / New York State College of Veterinary Medicine / P.O. Box 786 / Ithaca, N.Y. 14851-0786 / (607) 253-3333

Leptospira Serology (MAT)

No.	IDENTIFICATION/ SPECIES	LEPTOSPIRA SEROTYPES														
		POM	HAR	ICT/CI	GRI	CAN	BAL	WOL	AUT	BAT	TAR	AUS	PYR	BRA	SEJ	ICTA	JAV	SZW
1	Y2 17	—	—	—	—	—	EFS	seal	4/92									
2	Y6 74	—	—	—	—	—	EFS	seal	4/92									
3	Y2. 65	—	—	—	—	—	EFS	Pelvalo	5/92									
4	Y2. 18	—	—	—	—	—	EFS	seal	4/92									
5	Y2-65	—	—	—	—	—	EFS	Pelvalo	4/92									
6	Y2-15	—	—	—	—	—	EFS	Pelvalo	5/12/92									
7	Y6-63	—	—	—	—	—	EFS	seal	4-92									
8	Y2-67	—	—	—	—	—	EFS	Pelvalo.	5/12/92									
9	Y2-67	—	—	—	—	—	EFS	Pelvalo	5/12/92									
10	Y254	—	—	—	—	—	EFS	Pelvalo	5/92									

NOTE. All samples screened at a final dilution of 1/100; therefore "-" = negative at 1/100 unless otherwise indicated.

POM *L. pomona*
HAR *L. hardjo*
ICT/C *L. icterohaemorrhagiae / copenhageni*
GRI *L. grippotyphosa*
CAN *L. canicola*
BAL *L. ballum*
WOL *L. wolffi*
AUT *L. autumnalis*
BAT *L. bataviae*
TAR *L. tarassovi (mitis, hyos)*
AUS *L. australis*
PYR *L. pyrogenes*
BRA *L. bratislava*
SEJ *L. sejroe*
ICTA *L. icterohaemorrhagiae / icterohaemorrhagiae*
JAV *L. javanica*
SZW *L. szwajzak*

- [x] Please forward a second serum sample in 2-3 weeks. Refer to the above accession number. SAMPLE # 12
- [ ] A titer of 1/1600 or above for any one serotype is suggestive of recent infection with that serotype in the absence of recent vaccination for leptospirosis.
- [ ] A significant increase / decrease in titer has been noted for L. _____ on sample # _____, indicative of recent infection in the absence of recent vaccination for leptospirosis.
- [ ] It is unlikely that these results are significant.
- [ ] These results suggest recent vaccination for leptospirosis.
- [ ] These results suggest exposure to L. _____ at some time in the past.
- [ ] The above serum sample(s) was / were tested by microscopic agglutination for the serotypes indicated and found to be negative at: _____
- [ ] Sample(s) tested in parallel with previously submitted specimen(s). See (accession # _____)

COMMENTS

Date: 6/30/92 CJS

Authorized by: _____

Appendix A6.--Continued.

Diagnostic Lab
Bacteriology Report

Accession number: 658221

Owner: NATIONAL MARINE FISHERY SER

Diagnostic Laboratory · New York State College of Veterinary Medicine / P.O. Box 786 / Ithaca, N.Y. 14851-0786 / (607) 253-3333

Leptospira Serology (MAT)

No	IDENTIFICATION/ SPECIES	LEPTOSPIRA SEROTYPES														
		POM	HAR	ICT/CI	GRI	CAN	BAL	WOLI	AUT	BAT	TAR	AUS	PYR	BRA	SEJ	ICT/I	JAV	SZW
21	T 768	—	—	—	—	—	Layman 8 Bed - 1992											
2	T 764	—	—	—	—	—				"								
3	T 446	—	—	—	—	—				"								
4	G 064	—	—	—	—	—				"								
25	T 756	—	—	—	—	—				"								
6	T 58 M	—	—	—	—	—				"								
7	TT 38	—	—	—	—	—				"								
8	T 37 M	—	—	—	—	—				"								
9	T 17 M	—	—	—	—	—				"								
30	TL 24	—	—	—	—	—				"								

NOTE. All samples screened at a final dilution of 1/100; therefore "-" = negative at 1/100 unless otherwise indicated.

POM	*L. pomona*	WOL	*L. wolffi*	BRA	*L. bratislava*
HAR	*L. hardjo*	AUT	*L. autumnalis*	SEJ	*L. sejroe*
ICT/C	*L. icterohaemorrhagiae / copenhageni*	BAT	*L. bataviae*	ICT/I	*L. icterohaemorrhagiae / icterohaemorrhagiae*
GRI	*L. grippotyphosa*	TAR	*L. tarassovi (mitis, hyos)*		
CAN	*L. canicola*	AUS	*L. australis*	JAV	*L. javanica*
BAL	*L. ballum*	PYR	*L. pyrogenes*	SZW	*L. szwajizak*

- [x] Please forward a second serum sample in 2-3 weeks. Refer to the above accession number. (SAMPLE #12)
- [ ] A titer of 1/1600 or above for any one serotype is suggestive of recent infection with that serotype in the absence of recent vaccination for leptospirosis.
- [ ] A significant increase / decrease in titer has been noted for L. _____ on sample # _____ indicative of recent infection in the absence of recent vaccination for leptospirosis.
- [ ] It is unlikely that these results are significant.
- [ ] These results suggest recent vaccination for leptospirosis.
- [ ] These results suggest exposure to L. _____ at some time in the past.
- [ ] The above serum sample(s) was / were tested by microscopic agglutination for the serotypes indicated and found to be negative at: _____
- [ ] Sample(s) tested in parallel with previously submitted specimen(s). See (accession # _____).

COMMENTS

Date: 6/30/92 CTS

Authorized by: _____

Appendix A6.--Continued.

Diagnostic Lab
Bacteriology Report

Accession number: [illegible]

Owner: [illegible]

Diagnostic Laboratory / New York State College of Veterinary Medicine / P.O. Box 786 / Ithaca, N.Y. 14851-0786 / (607) 253-3333

Leptospira Serology (MAT)

No.	IDENTIFICATION/ SPECIES	LEPTOSPIRA SEROTYPES														
		POM	HAR	ICT/C	GRI	CAN	BAL	WOLI	AUT	BAT	TAR	AUS	PYR	BRA	SEJ	ICT/I	JAV	SZW
1	[illegible]	—	—	—	—	—	Current rabies seals 7/1/92 samples											
2	[illegible]	—	—	—	—	—						11						
3	[illegible]	—	—	—	1/100	—						11						
4	[illegible]	—	1/100	1/100	—	—						11						
5	[illegible]	—	1/100	1/100	—	—						11						
6																		
7																		
8																		
9																		
0																		

NOTE. All samples screened at a final dilution of 1/100; therefore "-" = negative at 1/100 unless otherwise indicated.

POM *L. pomona*
HAR *L. hardjo*
ICT/C *L. ictaronaemormagiae / copenhageni*
GRI *L. grippotyphosa*
CAN *L. canicola*
BAL *L. ballum*
WOL *L. wolffi*
AUT *L. autumnalis*
BAT *L. bataviae*
TAR *L. tarassovi (mitis, nyos)*
AUS *L. australis*
PYR *L. pyrogenes*
BRA *L. bratislava*
SEJ *L. sejroe*
ICT/I *L. ictaronaemormagiae / ictaronaemormagiae*
JAV *L. javanica*
SZW *L. szwajzak*

☐ Please forward a second serum sample in 2-3 weeks. Refer to the above accession number. Leptospira #2, 4 & 5

☐ A titer of 1/1600 or above for any one serotype is suggestive of recent infection with that serotype in the absence of recent vaccination for leptospirosis.

☐ A significant increase / decrease in titer has been noted for L. _____ on sample # _____, indicative of recent infection in the absence of recent vaccination for leptospirosis.

☐ It is unlikely that these results are significant.

☐ These results suggest recent vaccination for leptospirosis.

☐ These results suggest exposure to L. _____ at some time in the past.

☐ The above serum sample(s) was / were tested by microscopic agglutination for the serotypes indicated and found to be negative at: _____

☐ Sample(s) tested in parallel with previously submitted specimen(s). See (accession # _____)

COMMENTS

Date: [illegible]

Authorized by: [illegible]

APPENDIX B

MINUTES FROM THE HAWAIIAN MONK SEAL RECOVERY TEAM MEETING
4-5 JANUARY 1993, SEATTLE, WA

A meeting of the Hawaiian Monk Seal Recovery Team was held at the National Marine Mammal Laboratory, Northwest and Alaska Fisheries Science Center, Seattle, WA on 4-5 January 1993. In attendance were R. Brownell, R. DeLong, D. DeMaster (chair), L. Eberhardt, W. Gilmartin, A. Johnson, and I. Stirling. P. Kawamoto and G. Nitta where not able to attend. B. Becker, M. Craig, and T. Ragen from the SWFSC, Honolulu Laboratory attended and participated in the discussions. W. Perrin attended representing the Marine Mammal Commission. The agenda for the meeting is given in Appendix 1. Recommendations from the meeting are summarized in Appendix 2.

Introductory comments were provided by Gilmartin. DeMaster asked Perrin to formally thank the U.S. Marine Mammal Commission for providing travel support for non-government Recovery Team members. Further, DeMaster acknowledged that Becker and Craig paid their own travel costs to attend the meeting. Finally, DeMaster apologized to Team members for any inconveniences related to the short notice of having to cancel the originally scheduled Team meeting (2-3 December 1992 in Honolulu) and reschedule the meeting to 4-5 January in Seattle.

By-Island Summary of Population Status

Ragen summarized the status of each subpopulation (hereafter referred to as an island population). Most of the information presented during this review was taken directly from a draft report by Ragen, "Status of the Hawaiian monk seal in 1992." In response to a previous comment by Eberhardt, Ragen presented both the long term perspective of status (i.e., 1950s through 1992) and the short term perspective of status (i.e., 1988 through 1992). In summary, the island populations at French Frigate Shoals and Laysan have decreased since 1988; while the populations at Pearl and Hermes, and Kure have increased. The island population at Lisianski was stable since 1988. It was noted that the estimated number of deaths due to mobbings at Laysan Island in 1992 included three adult females (total mobbing related deaths were projected at 10). There was no census information for the Necker population in 1992, while 5 births were reported at Nihoa in 1992. The population at Midway has only recently been monitored, and therefore, trends in abundance are unknown. The island population at Midway prior to the introduction of 20 females was estimated to include a maximum of 20 individuals. At French Frigate Shoals, the population increased at approximately 8% per year between 1956 and 1976 and then decreased at an annual rate of 7% per year between 1985 and 1992. During the recent decline at FFS, the age group that

Appendix B.--Continued.

showed the sharpest decrease in numbers was the juvenile age group (i.e., 1-3 year old animals).

Ragen also presented a summary of the movement and diving data from three subadult males instrumented with satellite tags at FFS in September 1992. All of the at-sea positions were within 100km of FFS. A majority of the at-sea positions were within 20km of FFS and to the north of Tern Island. Concerning diving behavior, it was noted that almost all of the 7379 recorded dives were to a depth of less than 76m and that dives made in the evening hours were generally shallower than dives made during the day. Finally, Ragen summarized the diving behavior of 11 animals that were instrumented with time-depth recorders (TDRs) at Laysan Island in 1992. At Laysan, the maximum depth of dive was slightly in excess of 200m. Depth of dive frequencies were distributed bimodally with peaks at 30m and 60m.

Hawaiian Islands Marine Ecosystem Workshop

Gilmartin and Ragen summarized the proceedings of the Hawaiian Islands Marine Ecosystem workshop held in Honolulu, HI in December. It appears that a large-scale shift in the North Pacific gyre (NPG) to the south had occurred in the 1970s and 1980s. This shift likely resulted in, among other things, a decrease in surface temperatures and an increase in primary production. Recently, the NPG seems to have shifted back to a more northerly position, resulting in decreased productivity in the Hawaiian Islands. Information presented on the productivity of several upper level predators (e.g., two species of sea birds, monk seal, and spiny lobster) was consistent with the hypothesis that the marine productivity of at least the central Hawaiian Archipelago had decreased since the late 1980s. It was noted that the time series of data was simply too recent to capture the results of the initial movement of the NPG to the south. Further, it was noted that few data were available on relative changes in the productivity of primary and secondary producers in the Hawaiian Islands over the last three decades. The Recovery Team recommended that an analysis of available oceanographic data pertaining to or relevant to waters around the Northwest Hawaiian Islands be completed. The Team noted that the Service has several experts in the field of biological oceanography (e.g., Drs. Paul Fiedler, Mike Dahlberg, and Mike Laurs) and encouraged the Director, SWR, to solicit input from experts both within and outside the Service. The Team also discussed the possibility of testing the "environmental regime" hypothesis for explaining the recent decline in monk seals at FFS with data concerning monk seal food habits (i.e., analysis of scats, fine structure in teeth, etc.) and changes in the abundance of monk seal prey. Gilmartin and others noted several problems in these approaches.

Appendix B.--Continued.

FFS Population Status and Relocation Program to Midway

Gilmartin summarized recent activities concerning the rehabilitation of animals from FFS and the relocation of animals to Midway. A report summarizing the findings was distributed. By the end of 1992, 13 of the 21 animals relocated from FFS to Midway were still alive. Gilmartin noted that all of the translocated animals were screened for transmission of possible disease vectors. Low titers for Leptospira were reported, but this finding was considered non-threatening to the monk seal population at Midway. Similarly, positive findings for some species of internal parasites and Salmonella spp. were considered non-threatening. Gilmartin added that the decision to by-pass the step, whereby animals are first moved to Honolulu from FFS prior to moving to Midway, was skipped on this October relocation. Gilmartin suggested that improved veterinarian care at Midway with allowance for temporary transfer of sick seals to Honolulu for more intensive care as needed may improve the survival of relocated animals. The Team concurred with this suggested scheme. Further, weaned pups were found to handle the stress of the relocation and introduction to a new environment considerably better than animals two years old and older. Perrin commented that the success of this relocation program was considerably less than the FFS-Kure Island relocation program. Gilmartin responded that future relocations may only involve emaciated weaned pups and that this would likely improve the rate of survival. DeLong recommended that the growth rate of translocated pups and pups born at Midway be compared to aid in evaluation of the factors responsible for mortality in relocated pups. In addition, DeLong and Johnson noted that the sex ratio of the FFS population should be monitored closely because of the potential for increasing the percentage of males in the population following the relocation of female monk seals to Midway.

Analysis of Population Data and Information Needs

Eberhardt led the discussion on analysis of population data, which was based on a draft background document circulated at the meeting. Eberhardt noted the following: 1) discontinuing the annual monitoring program for each island population would irreparably damage our ability to determine survival rates of monk seals, 2) each island population must be managed with information from that specific population because all of the sites have different population characteristics, 3) it is essential that the analysis of existing data be brought up to date, for without this knowledge it will not be possible to improve data collection methods or identify additional information that should be gathered. He recommended that population models be developed for each island population and that a comprehensive analysis of methods of population estimation and survival be undertaken. A discussion of how to stream-line

Appendix B.--Continued.

data collection and editing followed. Ragen commented that the research team had recently begun direct computer-data entry and had eliminated a number of data fields that were considered redundant. He added that an annual summary of field results will be prepared and that the data reporting format for each island will be standardized.

Research and Management Recommendations at FFS

DeMaster led the discussion concerning research and management recommendations at FFS. It was noted that Gilmartin would use this discussion to help focus the development of a research and management plan for monk seals at FFS. The following ideas were suggested with priorities attached to each activity, where I means "highest priority and should be done," II means "important and should be done," and III means "priority, but not essential:"

Priority I:

1. Continue monitoring population annually (beach counts, births, sex ratio, age composition, survival, etc.).

2. Continue tagging weaned pups.

3. Follow up on ecosystem workshop findings and expand oceanographic studies as they relate to monk seal population dynamics.

4. Initiate inter-island comparison of behavioral data, specifically multi-island atolls with single islands sites.

5. Monitor growth rates of emaciated pups at FFS and compare to growth rates of pups born at Midway and those relocated from FFS to Midway.

6. Compare rates of growth for juveniles at FFS and Laysan.

7. Continue disease monitoring at FFS.

8. Develop "start/stop" criteria for relocating animals to Midway. Consider relocating some males.

9. Continue relocation of rehabilitated pups to Midway.

10. Continue restoration of habitat at Tern Island.

11. Increase efforts to locate tagged animals at Nihoa and Necker Islands.

12. Continue release of animals entangled in derelict fishing gear and marine debris.

Appendix B.--Continued.

13. Continue monitoring fishery interactions (SWR: place observers in NWHI).

14. Mitigate, as possible, harassment of monk seals during surveys for seabirds and sea turtles, and vice versa (utilize Section 7 or permit process, as appropriate).

15. Retag animals that have lost previously applied flipper tags.

16. Evaluate the degree to which tag loss may bias estimation of survival and population size.

17. Continue monitoring pup production and aggressive interactions.

18. Continue necropsy program and expand collection of tissues (e.g., National Tissue bank program).

19. Evaluate utility of applying larger PIT tags remotely.

20. Evaluate patterns in reproduction and compare with other islands.

Priority II:

1. Increase efforts to study foraging behavior.

2. Develop population model for FFS population and complete a PVA comparing persistence times for various manipulations.

3. Compile osteologic collection from FFS.

4. Evaluate potential for using remote sensing to monitor population.

Priority III:

1. Initiate analysis of genetic markers at FFS.

2. Evaluate potential for historical data on monk seals at Johnston Island.

3. Consider rehabilitating female pups on site at FFS (i.e.,

Appendix B.--Continued.

Alternative Recovery Team Meeting Schedule

The final agenda item discussed on the first day was item #10, which was led by Gilmartin. He noted that Dr. Boehlert had questioned whether an annual Recovery Team meeting was really necessary and had suggested using an alternate year schedule of a recovery team meeting rotating with meetings to address a specific topic, utilizing, as may be appropriate, other than Team expertise. After some discussion, the Recovery Team recommended continuing the annual schedule of meetings. Because the interaction among Team members and the monk seal research staff is considered critical to the overall success of the program, Team meetings should be held in Hawaii. Team members concurred that the familiarity of the monk seal staff with the field data and their presence at the Team meetings was important because it increased the Team's ability to ask detailed questions concerning monk seals. Because the field schedule for monk seal research begins early in the calendar year and because the opinions of the Team often affect the type of field work that is planned, early December is optimal for a meeting time. It was noted that additional workshops should be planned and held on an "as-needed" basis.

Mobbing Research Status and Recommendations

Gilmartin led the discussion concerning how to resolve the male-mobbing problem at Laysan. In 1992, he noted that most of the mobbing related deaths were in April (whereas in a typical year they occur between May and June). Further, 7 known deaths (2 adult females) and 3 "assumed" deaths (1 adult female) were related to mobbings. Gilmartin then presented a summary of the feasibility study to evaluate the potential for resolving the male mobbing problem at Laysan by "simulating" the removal of aggressive males by using a testosterone-suppressing drug. The experimental design and "start/stop" criteria developed at the previous year's Team meeting were discussed (Appendix 4). Gilmartin noted that the discriminant analysis used to identify aggressive males was not as useful as hoped and that it was difficult to find enough suitable males for treatments and controls. He added that there were no acute behavioral responses towards or by any of the 10 adult males treated with the drug, but that the blood tests of drugged animals indicated that testosterone levels had been reduced to levels approaching zero. Finally, it was noted that 10 adult males were not removed as recommended in the research protocol because of a lack of funding and an inability to locate facilities to take the seals.

DeMaster led the discussion concerning how to proceed with the evaluation of whether or not to permanently remove male monk seals from Laysan Island. The Team discussed the following options: 1) drug 50% of the males in 1993, 2) remove 50% of the males, 3) drug 10 males and remove 10 males, 4) drug 25 males and

remove 25 males, and 5) do nothing in 1993. The cost and relative benefits of each option were discussed. After a lengthy discussion, the Team recommended that up to 50 adult males at Laysan Island be injected with a testosterone-suppressing drug in 1993. Further, the Team recommended that if funding for this project was not available (estimated cost $100K) in FY-93, that a minimum of 10 adult males should be removed to captivity. The Team further recommended that funding should be made available to increase efforts to identify adult males that participate in mobbings at Laysan Island and to analyze behavioral data from all islands to allow for inter-island comparisons. Perrin commented that he thought a priority should be placed on actually observing a minimum number of mobbing events. In this way, specific individuals could be identified and information on how mobbing events are initiated might be determined. Gilmartin commented that the low frequency of mobbing events together with their uncertain location makes it very difficult to plan a study as proposed by Perrin. In some past years a high staff effort has been directed at locating mobbing events, but little has resulted from it.

Development of Protocol for Responding to Emergencies

Gilmartin introduced the topic of developing a protocol for responding to emergency situations and possibly pursue permit authority for such in a manner similar to the process used to authorize takes during "die-offs". An example of such a situation was the adult male monk seal at FFS that was observed killing pups. The Team concurred with the need to take action quickly in these situations and expressed concern that, given the small size of some of these island populations, even the loss of a few animals could significantly reduce population viability. Therefore, no significant delays in making decisions to remove animals or other managerial actions should occur. The Recovery Team recommended that, as necessary, the leader of the Marine Mammal Research Program at the Honolulu Laboratory be authorized to directly solicit opinions from Recovery Team members in emergency situations if that is necessary to obtain authorization to take action.

Permit Status and Needs

DeMaster led the discussion concerning permit status. Gilmartin noted that the general permit that authorizes research on monk seals expires in December 1993. DeMaster requested that Gilmartin summarize the status of all NMFS permits for monk seals in a table, which would be included as an appendix to the minutes of this meeting (Appendix 3).

Appendix B.--Continued.

Other Business

Concerning the suggestion to update the existing recovery plan, the Team considered such an action unnecessary at this time. Rather the Team encouraged Gilmartin to update the 1991-1993 workplan for monk seals through 1996. Also, Gilmartin noted that the proposed research by Drs. Katherine Ralls and Tony Starfield to evaluate the probability of success for various approaches to resolve the mobbing problem had not been funded, but some work was on-going. Brownell commented that in the status report prepared by Ragen that he should be consistent in the use of terms like "population" and "species". Gilmartin distributed an updated monk seal program publication list (Appendix 4).

The next Recovery Team meeting was tentatively scheduled for the week of December 2, 1993 in Honolulu. At that meeting, listing and delisting criteria under the ESA and MMPA will be discussed, among other items.

The Recovery Team voted to give letters of appreciation to Karl Kenyon, Dale Rice, and Cliff Fiscus for their pioneering work on the Hawaiian monk seal.

APPENDIXES TO APPENDIX B

Appendix B1. Meeting agenda

Appendix B2. List of recommendations from 4-5 January 1993 meeting

Appendix B3. Summary of permits (deleted from report)

Appendix B4. List of publications (deleted from report)

Appendix B1

HAWAIIAN MONK SEAL RECOVERY TEAM MEETING
AGENDA

Dates: 4-5 January 1993
Venue: National Marine Mammal Laboratory
Participants: DeMaster (Chair), Brownell, DeLong, Eberhardt, Gilmartin, Johnson, Kawamoto (absent), Stirling, SWR - Nitta (absent)
MMC observer- Perrin

AGENDA
0900 Monday 4 January 1993

1. By-Island (ex FFS) summary of 1992 Population Status and Recovery Needs (45 min)
2. FFS summary of 1992 Population Status and Recovery Needs (30 min)
3. Hawaiian Islands Marine Ecosystem Workshop (30 min)
4. FFS disease survey and seal collection, rehabilitation, and relocation efforts to Midway (2 hr)
5. Population Data Analysis Needs and Recommendations (1 hr)
6. FFS Research/Management Recommendations (1 hr)

0800 Tuesday 5 January 1993

7. Mobbing Research Status and Recommendations (2 hr)
8. Development of Protocol for Responding to Emergencies (e.g., aggressive males, emaciated animals, etc. 30 min)
9. Permit Status, Needs, and Recommendations
10. Alt. year schedule of general meeting and meeting to address specific topics (GWB suggestion).
11. Discussion of need to update existing Recovery Plan (30 min)
12. Review of recommendations to Regional Director

Appendix B2

HAWAIIAN MONK SEAL RECOVERY TEAM RECOMMENDATIONS
4-5 JANUARY 1993

1. The SWR should secure funding for annual Recovery Team meetings in Hawaii by early November.

To be an effective advisory body to the Director, SWR, Recovery Team members believe it is necessary to meet annually at a minimum. Scheduling is best accomplished by agreeing to next year's meeting date a year in advance. Because the field schedule for monk seals begins early in the calendar year and because of the minimum 90-day period to get MMPA permits, early December seems optimal for meeting. This timing also enables assembly of the previous field season's data for presentation to the Team. Finally, meeting in Hawaii allows the Team greater interaction with the monk seal staff. This interaction is extremely important because it allows the Team greater familiarity with recently available data, greater access to unanticipated data needs, and the opportunity to work directly with the monk seal staff. In addition, the Team recommends that the SWR allocate funds to cover the travel expenses of all of the members of the Recovery Team, as opposed to only funding members who do not work for the Federal government.

2. The level of support for the monk seal recovery program in FY-93 should be sufficient to allow monitoring of the five main breeding populations, relocation of animals from French Frigate Shoals to Midway, and resolution of mobbing problem at Laysan Island.

Recovery Team members are concerned that the probable level of funding for FY-93 will be insufficient to support the basic three programs that have been identified as being critical to the recovery of monk seals in Hawaii.

3. Funding in FY-93 should be made available to increase efforts to identify adult males at Laysan Island involved with mobbing and to analyze behavioral data from all islands.

The Recovery Team notes that efforts to identify adult males at Laysan Island involved with mobbing were not entirely successful in 1992. Therefore, the Team recommends that additional effort be directed at analyzing behavioral data from Laysan and the other breeding islands to address the question of how to identify "aggressive" males. If possible, the Team recommends that a workshop be organized in 1993 to review the findings of the analysis of the behavior data and to report the results of this workshop at the December 1993 Recovery Team meeting.

Appendix B2.--Continued.

4. Up to 50 adult males at Laysan Island should be injected with a testosterone-suppressing drug. Further, the necessary funding and permits to accomplish task should be secured.

Recovery Team members were informed that the probable funding level for FY-93 is such that the funding necessary to support the resolution of the mobbing problem at Laysan Island (ca $100K) is not available (i.e., funding to support injecting up to 50 males with a testosterone-suppressing drug). Further, the Team was extremely disappointed to hear that funding in FY-92 was not available to remove 10 males from Laysan Island, as recommended. At this point, the Team is frustrated that very little has been done to date to resolve the mobbing problem at Laysan Island and, if the level of support for the monk seal recovery program in FY93 is not increased, nothing will be done in FY93. At a minimum the Team recommends that, if funding to drug up to 50 adult males is not available, 10 adult males should be removed to captivity.

5. Placing observers on long-line and bottom-fish fishing vessels in the Northwestern Hawaiian Islands should continue.

The Recovery Team continues to be concerned over the potential for direct monk seal-fishery interactions that may be adversely affecting the monk seal population. Information on the extent to which monk seals either follow or interact with commercial fishing vessels in the vicinity of French Frigate Shoals is needed to evaluate the magnitude of this problem.

6. It should be appropriate for the Leader of the Marine Mammal Research Program, Honolulu Laboratory, SWFSC, to solicit opinions directly from the Recovery Team in emergency situations.

The Recovery Team commends the Service for its quick response, after identifying a male monk seal at French Frigate Shoals that was responsible for the deaths of several young seals. The Team acknowledges that it serves at the request of the Director, Southwest Regional Office. However, the Team recommends that in certain circumstances the Regional Director should allow the head of the monk seal research program to solicit an opinion directly from members of the monk seal Recovery Team. The Team further recommends that the staff of the Southwest Center, Region, and chair of the Recovery Team consult on specific criteria for emergency response.

7. Enforcement agent/s from the SWR should be stationed at Kure Atoll to monitor loran station clean up operations by the Coast Guard to ensure that seals are not disturbed.

The Recovery Team is concerned with the potential for disturbance to monk seals at Kure Atoll, especially lactating females with young pups, caused by the final disposal operations

Appendix B2.--Continued.

scheduled for this summer. As recommended at last year's meeting, the Team recommends that the SWR, NMFS monitor the station clean-up to ensure that seals are not disturbed.

8. A comprehensive review of findings from the workshop on variation in the marine environment and ecosystem around NWHI should be conducted. Further, additional efforts are needed to provide the information necessary to evaluate the extent to which large- and mesa-scale oceanographic events are impacting monk seals in the Northwestern Hawaiian Islands.

The Recovery Team recommends that an analysis of available oceanographic data pertaining to or relevant to waters around the Northwest Hawaiian Islands be completed. The Team notes that the Service has several experts in the field of biological oceanography (e.g., Drs. Paul Fiedler, Mike Dahlberg, and Mike Laurs) and encourages the Director to solicit input from the Service's experts and others.